A recommended method in order to interpret chest x-rays for diagnosing small size pneumothorax

3 authors, including:

Amin Saburi
Baqiyatallah University of Medical Sciences
156 PUBLICATIONS   **739** CITATIONS

SEE PROFILE

Some of the authors of this publication are also working on these related projects:

Project   shRNA-siRNA-cancer-Gene silensing-macrophage View project

Project   neuroimaging in children with metabolic disorders View project

A recommended method in order to interpret chest x-rays for diagnosing small size pneumothorax

Mohammad-Reza Ghane[1,2], Amin Saburi[3], Hamid-Reza Javadzadeh[1,2]

[1]Trauma Research Center, Baqiyatallah University of Medical Sciences, Tehran, [2]Department of Emergency Medicine, Faculty of Medicine, Baqiyatallah University of Medical Sciences, Tehran, [3]Chemical Injuries Research Center, Baqiyatallah University of Medical Sciences, Tehran, I. R. Iran

Address for correspondence:
Dr. Amin Saburi,
Chemical Injuries Research Center, Baqiyatallah University of Medical Sciences, Mollasadra St, Vanak Sq, Tehran, I. R., Iran.
E-mail: aminsaburi@yahoo.com

ABSTRACT

Background: Pneumothorax can be a both progressive and life threatening disorder. In this survey we evaluated the diagnostic accuracy of a recommended method for the interpretation of chest X-Rays (CXRs) compared to the common method in diagnosis of iatrogenic Pneumothorax in an emergency department.

Materials and Methods: We conducted a study on 100 CXRs (31 with the diagnosis of small size pneumothorax and 69 normal) of patients who have undergone the upper central venous catheterization. CXRs were interpreted by 5 Emergency Specialists (ESs) and 5 general practitioners (GPs) separately using the conventional and recommended method. Recommended method included a 90 degree rotation against the side of chateterization in addition to using a yellow shield as the background color. Presence of pneumothorax on the CXR was confirmed by a radiologist.

Results: 64.5% of the CXRs with pneumothorax were correctly diagnosed by GPs and 87.7% by ESs with reutine method and 83.2% and 97.4% by recommended method, respectively (P.value<0.001). 96.8% out of all CXRs were correctly diagnosed by GPs and 99.4% by ESs by conventional method and 97.9% by GP and 99.7% by ES was correctly diagnosed using recommended method(P.value<0.001). None of the underlying variables including sex, age, underlying diseases, the side of intervention did not affect on the diagnostic accuracy in either groups (P.value>0.05).

Conclusion: A significant raise was obtained in the diagnostic accuracy of CXR using the recommended method. This study can be a preliminary study to conduct further investigations in order to enhance the diagnostic accuracy of CXRs.

Key Words: Central venous catheterization, chest x-ray, diagnostic accuracy, iatrogenic pneumothorax, interpretation

INTRODUCTION

Today, Chest X-Ray (CXR) is the first and simplest method to examine the chest related pathology throughout the world.[1,2] Although various options such as computed tomography are also commonly recommended to increase the accuracy of diagnosis, CXR remains a valuable imaging modalities that is initially used for the evaluation of the chest and its related organs such as plural cavity at the first line.[3] Pneumothorax is a serious disorder that can be both progressive and life threatening indicated with the presence of air in the plural cavity.[4] Iatrogenic Pneumothorax (IP) is a secondary pneumothorax which can occur after any intervention on chest such as central venous catheterization, a lung or plural biopsy and aspiration.[5] IP usually appears as a small size lesion and so the misdiagnosed small-size pneumothox isn't uncommon and it can be progressed chronically and rarely treats the haemodynamic status of patients.[6]

Recent technical modifications such as digitalization improved the diagnostic accuracy of CXRs although these expensive modifications should be apllied during imaging.[3,7,8] We tried to find a way to improve the diagnostic accuracy of CXR during interpretation while it is inexpensive. Due to the more sensitivity of human eyes to some colors than the other ones, such as yellow

and green, we used the yellow as the background color of a negatoscope when a radiograph is interpreted.[9-11] In this pilot study we assessed the diagnostic accuracy of this new methods of interpretation compared to the usual methods for interpreting of CXR to diagnosis IP.

MATERIALS AND METHODS

In a cross-sectional study, 100 postero-anterior CXRs of patients who referred to the emergency department (ED) of ShahidChamran hospital, Tehran, Iran during 2009-2010 were evaluated by two methods of CXR interpretation. CXRs of patients who underwent upper central venous catheterization were included. All of them were acquired supine with the same instruments and and the Digital or PACS technologies was not used. The presence or absence of pneumothorax was confirmed by a radiologist (gold standard) and in suspected cases diagnosis was confirmed by CT scan therefore the radiologist diagnostic accuracy was as 100%. The CXRs were divided into two separated match groups in according to the radiologist's diagnosis (pneumothorax vs. normal).

Finally, thirty-one CXRs diagnosed with the small size IP and 69 normal CXRs were enrolled. The small size IP was indicated as an intra pural space lesion with a diameter less than 2 centimeters.[12] Five emergency medicine specialists (ES) and five general practitioners (GP) interpreted all of the CXRs by using the conventional and recommended methods separately. All of the ESs and GPs had enough experiice in working at ED (at least 3 years) and all of them were trainted for this study by a CXR interpretation workshop.

As shown in Figure 1, the conventional (routine) method for interpreting CXRs was reading and interpreting a CXR placed on a negatoscope with white light while. The recommended method included a 90 degree rotation against the side of intervention by using yellow shield as the background color. All physicians had enough

experience to interpret the CXR and had to diagnose the CXR for small size pneumothorax during one minute.

The results were analyzed using the SPSS 17th edition (SPSS Inc, Chicago, USA) by statistical frequency, Chi-square, Mcnemmar and Generalized Estimating Equations (GEE) tests and *P* value < 0.05 was considered statistically significant.

RESULTS

The mean (±Standard deviation) age of the patients was 69.97±10.00 and 48(48%) cases were males. The frequency of underlying disorders which implicated the Central Venous catetrization was showed in Table 1 and Sepsis (41%) was the most frequent underlying disorder. 64.5% of the CXRs with pneumothorax were diagnosed by GPs and 87.7% by ESs with the common method correctly and also 83.2% and 97.4% using recommended method, respectively. 96.8% of all CXRs were correctly diagnosed by GPs and 99.4% by ESs by using the conventional method and 97.9% by GPs and 99.7% by ESs were correctly diagnosed by recommended method that the difference between the two methods was statistically significant (*P* < 0.001) [Table 2].

Using the general estimating equation test, it was revealed that the total diagnostic accuracy by the conventional method was 91.4% versus the 96.2% by the recommended method; and this difference was statistically significant (*P* < 0.001, Odd's ratio: 2.398, CI: 1.871-3.073). None of the underlying variables including sex (*P*: 0.427), age (*P*: 0.825), underlying diseases (*P*: 0.579), the side of intervention (*P*: 0.438) did not affect on the diagnostic accuracy of either physician groups although the diagnostic accuracy in ESs significantly was higher than GPs (*P* < 0.001).

Finally, the sensitivity and specificity of conventional methods were estimated at 76.13% and 98.26% and the sensitivity and specificity of recommended methods were estimated at 90.32% and 98.84%, respectively.
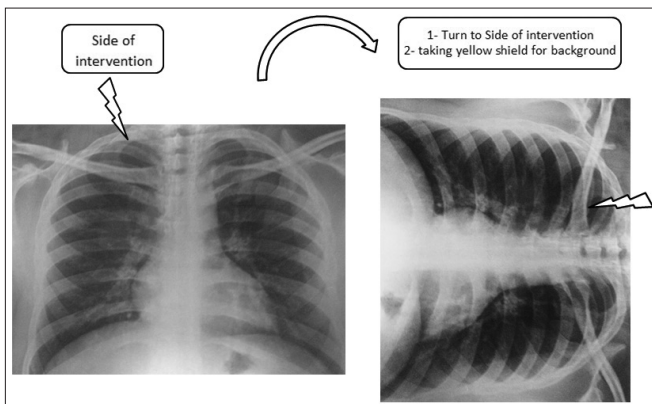

Figure 1: New methods in order to CXRs interpretation

Table 1: Baseline characteristics

Item		Pneumothorax	Normal
Age ± SD (y)		60.80 ± 10.54	63.94 ± 9.68
Gender	Male	15 (48.4%)	33 (47.8%)
	Female	16 (51.6%)	36 (52.2%)
Side of intervention	Right	27 (87.1%)	64 (92.8%)
	Left	4 (12.9%)	5 (7.2%)
Underlying diseases	Sepsis	13 (41.9%)	28 (40.6%)
	ESRD	6 (19.4%)	13 (18.8%)
	GIB	6 (19.4%)	8 (11.6%)
	Shock	1 (3.2%)	7 (10.1%)
	M.T	3 (9.7%)	6 (8.7%)
	IV	2 (6.5%)	7 (10.1%)

M.T: multiple trauma, IV: intra venous access, GIB: gastro-intestinal bleeding, ESRD: End Stage Renal Diseases, SD: standard deviation. y: years. *P*-value in all filed between two groups were not significant.(P > 0.05)

Table 2: The diagnostic accuracy of two methods by general practitioner and specialists

Diagnosis		General practitioner						Specialist					
		GP1%	GP2%	GP3%	GP4%	GP5%	Total%	SP1%	SP2%	SP3%	SP4%	SP5%	Total%
Usual	Pneumothorax	61.2	58.1	38.7	83.8	80.6	64.5	87.1	90.3	77.4	96.7	87.1	87.7
method	Normal	95.6	94.2	98.5	100	97.1	97.1	100	98.5	100	100	98.5	99.4
	Total	85	83	80	95	92	96.8	96	96	93	99	95	99.4
Recommended	Pneumothorax	77.4	83.8	64.5	93.5	96.7	83.2	100	96.7	90.3	100	100	97.4
method	Normal	98.5	92.7	98.5	100	100	97.9	100	100	98.5	100	100	99.7
	Total	92	90	88	98	99	97.9	100	99	96	100	100	99.7
P value				<0.001						<0.001			

GP: General practitioner, ES: emergency specialist

DISCUSSION

Our findings indicate that the diagnostic accuracy of CXRs in ESs is clearly higher than GPs, but the diagnostic accuracy of both physician groups is higher than the values in the similar studies.[13] This difference may be cause of the training given to the emergency department physicians.[14] Significant raise was seen in the diagnostic accuracy of CXRs using the recommended method. Notwithstanding the diagnosis of pneumothorax is vital, the maldiagnosisof IP in CXR isnt't rare, especially in emergency department.[15] In recent studies, researcher attempted to increase the diagnostic accuracy of CXR especially in general practitioners and non-radiologist physicians by technical improvement but the researchers turned out to be costly protocols.[7,8,16] Developing in techniques and the equipments of diagnostic imaging (such as digitalization) make progress in the quality of CXR, but because it is too expensive to use in limited health care units.[8] On the other hand, the diagnostic accuracy of CXR taken by these methods was slightly significantly different in compared to usual methods. And there was some diagnostic model for decrease the diagnostic fault.[17] Although CXR is a useful clinical imaging technique in emergency department, especially for the primry evaluation, the diagnostic accuracy of CXRs still depends on the experience of the clinician who interprets it.[15]

The diagnosis of small size pneumothorax, especially in complicated case with other thoracic lesion (such as pneumonia or congestive heart failure) is difficult.[18] Recent reports demonstrated that the diagnostic accuracy of CXRs for pneumothorax is widely varied.[3,19,20] This study can be a preliminary study in order to conduct further investigation to enhance the diagnostic accuracy of CXRs. This study, as an evidence-based medical research, was conducted based on the higher sensitivity of the human eye to yellow rather than white, as well as the higher sensitivity to horizontal parallel lines rather than vertical lines.[9,11,21]

CONCLUSION

Taking into account a significant raise which was obtained in the diagnostic accuracy of CXR using the recommended method compared to traditional method, this study can be a preliminary study to conduct further investigations in order to enhance the diagnostic accuracy of CXRs. It seems that improvements in the diagnostic accuracy of CXR by developing on the technique of interpretion were more advantageus than technical improvements in the quality of CXRs.

AKNOWLEDGEMENT

REFERENCES

1. Tarrac SE. A systematic approach to chest x-ray interpretation in the perianesthesia unit. J Perianesth Nurs 2009;24:41-7;quiz 47-9.
2. Cortes-Telles, A, Mendoza D, Relevance of an incidental chest finding. Lung India 2012;29:50-2.
3. Pihlajamaa K, Bode MK, Puumalainen T, Lehtimäki A, Marjelund S, Tikkakoski T. Pneumothorax and the value of chest radiography after ultrasound-guided thoracocentesis. Acta Radiol 2004;45:828-32.
4. Ball CG, Kirkpatrick AW, Feliciano DV. The occult pneumothorax: What have we learned? Can J Surg 2009;52:E173-9.
5. Kröpil P, Bilk P, Quentin M, Miese FR, Lanzman RS, Scherer A. CT-guided biopsy of thoracic lesions with a novel wire-based needle guide device-initial experiences. Acta Radiol 2011;52:866-70.
6. Matsumoto S, Kishikawa M, Hayakawa K, Narumi A, Matsunami K, Kitano M.A method to detect occult pneumothorax with chest radiography. Ann Emerg Med 2011;57:378-81.
7. Salazar AJ, Camacho JC, Aguirre DA. Agreement and reading time for differently-priced devices for the digital capture of X-ray films. J Telemed Telecare 2011;18:82-5.
8. Salazar AJ, Camacho JC, Aguirre DA. Comparison between different cost devices for digital capture of X-ray films: An image characteristics detection approach. J Digit Imaging 2012;25:91-100.
9. Mullen KT, The contrast sensitivity of human color vision to red-green and blue-yellow chromatic gratings. J Physiol 1985;359:381-400.
10. Normann RA, Perlman I, Daly SJ. Mixing of color signals by turtle cone photoreceptors. J Neurophysiol 1985;54:293-303.
11. Auras R, Lim LT, Selke SE, Tsuji H, editors. In Poly (Lactic Acid): Synthesis, Structures, Properties, Processing, and Applications. Hoboken, NJ, USA: John Wiley & Sons, Inc., 2010. p. 97-113.
12. Henry M, Arnold T, Harvey J. BTS guidelines for the management of spontaneous pneumothorax. Thorax 2003;58 Suppl 2:ii39-52.

13. Stanescu L, Talner LB, Mann FA. Diagnostic errors in polytrauma: A structured review of the recent literature. Emerg Radiol 2006;12:119-23.

14. O'Brien KE, Cannarozzi ML, Torre DM, Mechaber AJ, Durning SJ. Training and assessment of CXR/basic radiology interpretation skills: Results from the 2005 CDIM Survey. Teach Learn Med 2008;20:157-62.

15. Kaufman B, Dhar P, O'Neill DK, Leitman B, Fermon CM, Wahlander SB, *et al*. Chest radiograph interpretation skills of anesthesiologists. J Cardiothorac Vasc Anesth 2001;15:680-3.

16. Beningfield S, Potgieter H, Nicol A, van As S, Bowie G, Hering E, *et al*. Report on a new type of trauma full-body digital X-ray machine. Emerg Radiol 2003;10:23-9.

17. Isberg B, Thorstensen O, Jorulf H. Validation of diagnostic imaging based on repeat examinations. An image interpretation model. Acta Radiol 2004;45:540-6.

18. Collins SP, Lindsell CJ, Storrow AB, Abraham WT; ADHERE Scientific Advisory Committee, Investigators and Study Group. Prevalence of negative chest radiography results in the emergency department patient with decompensated heart failure. Ann Emerg Med 2006;47:13-8.

19. Ding W, Shen Y, Yang J, He X, Zhang M. Diagnosis of pneumothorax by radiography and ultrasonography: A meta-analysis. Chest 2011;140: 859-66.

20. Ghane MR, Saburi E, Saburi A. Diagnostic accuracy of general physician versus emergency medicine specialist in interpretation of chest x-ray suspected for iatrogenic pneumothorax: A brief report. Tehran University Medical Journal 2012;69:799-803.

21. Lynch KC, Oliveira CR, Matheson JS, Mitchell MA, O'Brien RT. Detection of pneumothorax and pleural effusion with horizontal beam radiography. Vet Radiol Ultrasound 2012;53:38-43.