ORIGINAL ARTICLE

Role of Chest Radiography in the Management of Patients with Chest Pain and Dyspnea in the Emergency Department

Ahmet DEMİRCAN,[1] Özgür KARCIOĞLU,[2] Sedat YANTURALI,[2] Ayfer KELEŞ,[1] Nazmiye KOYUNCU,[3] D. Niyazi ÖZÜÇELİK,[4] Suna SOYSAL,[2] Belgin ÜNAL,[5] Pınar BALCI,[6] Arif H. CIMRIN[7]

[1]Gazi University Hospital, Department of Emergency Medicine, Ankara

[2]Dokuz Eylül University Hospital, Department of Emergency Medicine, İzmir

[3]Bayındır Hospital, Department of Emergency Medicine, Ankara

[4]Hacettepe University Hospital, Department of Emergency Medicine, Ankara

[5]Dokuz Eylül University Hospital, Department of Public Health, İzmir

[6]Dokuz Eylül University Hospital, Department of Radiology, İzmir

[7]Dokuz Eylül University Hospital, Department of Pulmonary Medicine, İzmir

SUMMARY

Objectives: Study objective was to investigate the contribution of chest radiography on the management of patients with chest pain or dyspnea and to analyze the consistency of the treatment strategies before and after chest radiography.

Materials and Methods: All consecutive adult patients who were admitted to the emergency department with the chief complaint of non-traumatic chest pain or dyspnea who had a chest radiography were enrolled in the study.

Results: The impact of chest radiography on the management plan was investigated. The management plans were changed in 12.9% of 387 subjects after chest radiography. The change of management plans was not significantly related to age, sex, past medical history and radiographic technique. Presenting symptom, initial diagnosis, chest radiography indications,the initial management plan were all associated with management plan change after radiographic evaluation.

Conclusion: Chest radiographs may contribute to the diagnosis and treatment of selected emergency department patients with dyspnea and chest pain. Radiographies ordered routinely for hospital admission or for pre-operation testing had no impact on the patient management plan in the emergency department.

Key words: Chest radiography; chest pain; dyspnea; emergency department.

İletişim (Correspondence)

Ahmet DEMİRCAN, M.D.

Gazi University, Medical School,
Department of Emergency Medicine
06500 Beşevler, Ankara, Turkey
Tel: +90 - 312 - 202 50 45
Fax (Faks): +90 - 312 - 223 05 28
e-mail (e-posta): demircan@gazi.edu.tr

Introduction

Utilized as a screening and a diagnostic tool, chest radiograph is the imaging method most commonly ordered in the world.[1,2] One sixth of all radiographs obtained in the emergency departments (EDs) consist of chest radiography.[3] Cost-effective and rational utilization of chest radiographs has been a major concern in the literature. Researchers keep questioning if adjunctive tests and imaging modalities led to loss of workforce and financial resources besides contributing into clinical decision making processes. Clinical decision rules are being developed to increase the yield elicited from the diagnostic tools and to prohibit wasting of resources.[4]

The objective of this study is to investigate the contribution of chest radiography in the emergency department (ED) diagnosis and treatment plan of patients with chest pain and dyspnea and to analyze the consistency of the treatment strategies before and after the radiography.

Materials and Methods

This cross-sectional, prospective observational study was carried out in the university ED between July 1 and September 1, 2000 after approval of the Ethical Committee had been received. All consecutive adult patients (over 18 years old) who had been admitted to the ED with the chief complaints of non-traumatic chest pain or dyspnea and whose chest radiography had been obtained were enrolled in the study. Postero-anterior or antero-posterior chest radiographs were ordered for the patients. Antero-posterior technique was used bed side for critical patient. Excluded from the study were those with a history of recent thoracoabdominal trauma and those who had not given informed consent.

The study was conducted at university hospital academic ED which emergency physicians (EPs) and residents have primary responsible of patients' care and management. All study patients were examined and diagnostic tests and treatment plans were put into practice as usual. After initial clinical evaluation, study data sheets were given to EPs before chest radiography was obtained. The EPs recorded the chest radiography indications, initial diagnosis and initial treatment plan. Chest radiography indications were divided in five categories as a follow: confirmation of diagnosis, rule out of life threatening conditions (aortic dissection, pneumothorax etc), request of consultants, routine for admission or operation and the others. Initial treatment plans were divided in four categories as a follow: discharge with prescription, discharge without prescription, admission to ward, admission to Intensive Care Unit (ICU).

After chest radiography was obtained and performed radiographic evaluation, the EPs recorded final diagnosis and new management plan. And also patients presenting symptoms, demographic data, comorbid conditions and findings in chest radiography were recorded. Comorbid conditions were recorded as a no comorbid condition, pulmonary diseases and cardiac diseases. All chest radiographs were interpreted by the EPs in the ED and then checked by a senior radiologist to prevent for radiological missed diagnosis.

The relationship of demographic data, presenting symptoms, findings in chest radiography, comorbid conditions, technique of radiograph, clinical initial diagnosis and initial treatment plan with the change in treatment plan after chest radiography was analyzed with chi-square test and the consistency between the first and last treatment plans was analyzed with kappa statistics. P values below .05 were considered to be statistically significant.

Results

387 adult patients (218 male, 56.3%), were enrolled in the study. Mean age of patients was 57.33, SD: 16.21 and ranged from 18 to 98. The most common symptom in presentation was chest pain (n=221, 57.1%) followed by Shortness Of Breath (SOB) (n=130, 33.6%) and both (n=36, 9.3%).

The most common chest radiography indication was rule out life threatening conditions (55%). Other indications were as a follow: confirmation of diagnosis (36.4), routine for admission (6.4%), and operation request of consultants (2.1%).

Unstable angina pectoris (UAP) (26.4%) was the most common entities among the initial diagnoses, and nonspecific chest pain (NSCP) (24.0%) was the most common among the final diagnosis (30%) with the help of serial cardiac enzymes and electro cardiograms. Distribution of initial and final diagnoses was shown in Table 1.

Initial treatment plan was recorded by EPs, discharge with prescription (34.1%) was found to be the most common mode of disposition planned while percentage of admission to ICU, discharge without prescription, admission to ward were 31.0%, 17.8%, 17.1%, respectively. Final treatment plan was recorded discharge with prescription (38.0%) was found to be the most common mode of disposition planned while percentage of admission to ICU, discharge without prescription, admission to ward were 26.4.0%, 22.2%, 13.4%, respectively. More than a half of the chest radiographs obtained were interpreted as normal. Distribution of radiographic abnormalities was shown in Table 2. Clinical initial diagnosis was found to be consistent with radiological diagnosis in 327 patients (84.5%).

Table 1. *Distribution of initial and final diagnoses considered in the study patients.*

Diagnoses	Initial diagnoses		Final diagnoses	
	n	%	n	%
Nonspecific SOB	12	3.1	25	6.5
COPD exacerbation	31	8.0	33	8.5
Asthma exacerbation	16	4.1	16	4.1
Pneumonia	15	3.9	13	3.4
Pneumothorax	6	1.6	6	1.6
Pulmonary tumor complications	5	1.3	8	2.1
Nonspecific chest pain	93	24.0	116	3.0
Stable angina pectoris	21	5.4	14	3.6
Unstable angina pectoris	102	26.4	72	18.6
Myocardial infarction	21	5.4	30	7.8
CHF	33	8.5	30	7.7
Acute pulmonary edema	12	3.1	16	4.1
Other diseases	20	5.2	8	2.1
Total	387	100.0	387	100.0

Table 2. *Relation between presenting symptom and treatment plan change after chest radiography.*

Presenting symptom	Plan change		No change		Total	
	n	%	n	%	n	%
SOB	29	22.3	101	77.7	130	100.0
Chest pain	15	6.8	206	93.2	221	100.0
SOB and chest pain	6	16.7	30	83.3	36	100.0
Total	50	12.9	337	87.1	387	100.0

χ^2=18.02; SD=2; p=.001.

Treatment plans were changed after chest radiography interpretations in 50 (12.9%) out of 387 study patients. The difference between patients with and without treatment plan change after chest radiography regarding sex, age and past medical history were not found statistically significant (For sex χ^2=0.438, SD=1, p=0.508, for age Student t test p=0.12, for past medical history, χ^2=0.77, SD=2, p=0.68).

Postero-anterior chest radiographs were obtained in 261 patients and in 33 cases (12.6%) treatment plans were changed. Antero-posterior chest radiographs were obtained in 126 patients and in 17 cases (13.5%) treatment plans were changed. The difference between groups of beam directions regarding plan change was not found statistically significant (p=0.82).

The relation between radiography indications and treatment plan change was found statistically significant (p=.001). Only 8 radiographies ordered for request of consultants and two radiographies changed the clinical decision (25%). Followed by confirmation of diagnosis (24.8%), rule out of life threat-

ening conditions (6.1%). Radiographies ordered for routine for admission had no impact on management plan.

The relation between presenting symptom and treatment plan change after chest radiography was found statistically significant (p=.001). The highest rate of change was seen in patients presented with SOB (22.3%) followed by SOB together with chest pain (16.7%) and those only with chest pain (6.8%) (Table 3).

Statistically significant relation was found between the initial diagnosis and plan change after chest radiography (p=.001). The highest rate of change was recorded in patients with pulmonary diseases (27.7%) followed by cardiac diseases (11.1%). The smallest change was in patients with nonspecific SOB and NSCP (4.8%) (Table 4). Among patients with pulmonary diseases, those with initial diagnoses of pneumonia had the highest rate of management plan change (66.7%). Patients with congestive heart failure (CHF) (30.3%) had the greatest figure in patients with cardiac diseases. There was no

Table 3. *Relation between initial management plan and management plan change after chest radiography.*

Initial treatment plan	Plan change		No change		Total	
	n	%	n	%	n	%
Discharge without prescription	4	5.8	65	94.2	69	100.0
Discharge with prescription	16	12.1	116	87.9	132	100.0
Admission to ward	16	24.2	50	75.8	66	100.0
Intensive care unit	14	11.7	106	88.3	120	100.0
Total	50	12.9	337	87.1	387	100.0

$\chi^2=10.87$; SD=3; p=.012.

change at all in the patients with nonspecific SOB while only 5.4% was changed in those with NSCP.

Initial management plan was found significantly related to plan change after chest radiography (p=.012). The greatest rate of change was found in patients who were candidates of admission to ward (24.2%), followed by discharge with prescription (12.1%) (Table 3). The consistency between initial and final management plans was found statistically significant (kappa=0.68, p=.001) (Table 4).

Final diagnoses of the patients were found significantly related to change of management plan after chest radiography (p=.001). The greatest ratio of change was encountered in patients with pulmonary diseases (26.3%).

Discussion

Many patients are admitted to EDs with CHEST PAIN and/or SOB and chest radiography are extensively used in evaluating them. Chest radiography is still among the most important diagnostic tools for cardiovascular and pulmonary diseases despite rapidly evolving imaging technology.[1,2]

Emerman et al.[5] analyzed 685 chest radiography obtained from 285 Chronic Obstructive Pulmonary Disease (COPD) cases retrospectively and detected clinically significant

pathologies in 109 (16%) cases. They recommended chest radiography be taken to all cases with COPD and reported that one fourth of all radiographic findings would have been missed if chest radiography had not been obtained. In a prospective investigation of 128 COPD cases admitted to hospital, Tsai et al.[6] found that management plans were changed in 26 of 86 complicated cases after chest radiography whereas 44 uncomplicated cases were not affected. They advocated that graphs would not be beneficial in uncomplicated COPD patients. Sherman et al.[7] analyzed preadmission chest radiography of 242 COPD cases and found 14 percent of these abnormal. Five percent of those with abnormal chest radiography were subject to changes in management plan.

In our study eight (24.2%) of the 33 COPD patients experienced changes in management plan according to the chest radiography interpretation. Chest radiography verified the diagnosis in five while it ruled out suspected pneumonia in two and identified findings compatible with COPD in a patient with suspected CHF. It appears that chest radiography was effective in identifying precipitating factors such as CHF and pneumonia in patients admitted to the ED with SOB and in scheduling admission and prescriptions. Our results are generally consistent with literature data and we recommend chest radiography be taken for COPD patients.

Table 4. *Consistency between initial and final treatment plan.*

Final plan	Discharge without prescription		Discharge with prescription		Admission to ward		Intensive care unit		Total	
Initial plan	n	%	n	%	n	%	n	%	n	%
Discharge without prescription	62	89.9	5	7.2	1	1.4	1	1.4	69	100.0
Discharge with prescription	11	8.3	108	81.8	7	5.3	6	4.5	132	100.0
Admission to ward	7	10.6	16	24.2	38	57.6	5	7.6	66	100.0
Intensive care unit	6	5.0	18	15.0	6	5.0	90	75.0	120	100.0
Total	86	22.2	147	38.0	52	13.4	102	26.4	387	100.0

Kappa=0.68; p=.001.

Aranson et al.[8] reported that chest radiography did not change clinical decision making in 81 uncomplicated patients with asthma while 13 chest radiography out of 21 complicated cases affected decisions. They suggested not ordering chest radiography for uncomplicated cases. In a prospective study of 19 patients admitted for asthma, Findley et al.[9] found that eight had normal chest radiography and no patient harbored pneumothorax. The authors suggested taking chest radiography should clinically suspected pathologies exist.

In our study only one case (6.3%) was subject to change in management plan following chest radiography out of 16 cases with asthma. This case was first suspected to have pneumonia but was discharged with prescription after no finding was detected in chest radiography. The association found in our study between chest radiography findings and management plan change appears to be consistent with literature data. We also suggest that chest radiography were of no additional benefit in patients admitted to the ED with uncomplicated asthma exacerbations and respond to medical treatment.

In a multi-centered prospective study of 1.134 patients admitted with acute respiratory problems Heckerling et al.[10] put forth that certain clinical findings should be sought in ordering chest radiography. In our study pneumonia was diagnosed in 13 patients (3.4%) after chest radiography, exam and other investigations out of 15 with suspected pneumonia. Chest radiography affected the final diagnosis in seven patients (53.8%). Initial diagnoses were verified with chest radiography in five patients with suspected pneumonia while two cases with suspected stable angina pectoris were diagnosed as pneumonia. Chest radiography could be omitted in low-risk patients since missed diagnoses would not cause significant consequences.[11] On the other hand, chest radiography would be beneficial in morbid patients and in those with significant findings in exam.

Six cases were diagnosed as having pneumothorax in our study. We suggest chest radiography be obtained in patients with suspected pneumothorax as the entity might occur without specific clinical appearance.

Clinton[4] reported that it was of questionable benefit to obtain chest radiography to screen pulmonary cancer. Hubbel et al.[12] identified a mass lesion in one patient among 294 patients in their study while it had no effect on mortality. Chest radiography are not ordered as a screening tool for pulmonary cancer in our ED. On the contrary, no mass lesion was identified in our 387 patients. In two patients (2%) out of eight with known pulmonary cancer, treatment plans were changed for pleural effusions detected in chest radiography. We recommend chest radiography be obtained in these patients because together with primary disease, certain complications might result in exacerbations of SOB and redirect treatment plans.

In a prospective study of 99 patients with chest pain in the ED, Russell et al.[13] identified radiological pathologies in 33 percent of the subjects whereas 14 percent had clinically significant results. In a prospective study of 297 patients admitted to the ED with CHEST PAIN, Templeton et al.[14] found that 44 percent of the chest radiography obtained were abnormal and 23 percent had resulted in changes in diagnosis and treatment plan. They put forth that chest radiography would be beneficial in patients with chest pain. Benacerraf et al.[15] analyzed 1.102 patients admitted with any thoracic symptom. They found abnormalities in 96 percent of in those younger than 40 years of age without symptoms and examination findings. Mediastinal masses and pneumonia were detected in 2.3 percent. They advocated chest radiography be elicited in those older than 40 with thoracic complaints.

In the current study, chest pain constitute a substantial part of complaints on presentation. Chest radiography was ordered for all patients in this group. Thirty cases were diagnosed as CHF and in eight of them (26.6%) management plans were changed according to chest radiography findings.

Three cases (18.8%) among 15 with acute pulmonary edema had chest radiography that affected treatment plans. Suspected initial diagnosis was verified in one case, pneumonia was ruled out in one and acute pulmonary edema was detected in another instead of CHF considered initially. Treatment plans were changed in two patients out of 14 with stable angina pectoris after chest radiography. One was detected to have CHF and one had COPD. Three cases (4.2%) out of 72 with UAP were found to have COPD, COPD with CHF and aortic dissection. Those patients experienced changes in treatment plans. One patient (3.3%) out of thirty patients with myocardial infarction (MI) was subject to treatment plan change. This case turned out to have acute pulmonary edema. On the other hand, only six (5.2%) out of 116 patients diagnosed as NSCP experienced changes in prescriptions or treatment plans after chest radiography.

Hubbel et al.[12] estimated that 52 millions of chest radiography were obtained in 1980 in USA and sixty percent were ordered in a routine manner and cost nearly 1.5 billion dollars. The authors advocated not ordering chest radiography routinely because only four percent caused a change in treatment plans.

Clinton et al.[4] indicated that preadmission routine chest radiographs are not warranted in those without findings of

cardiopulmonary diseases. Tape et al.[16] reported that chest radiography constitute fifty percent of all x-rays ordered and most were obtained routinely preadmission and preoperatively. Six to forty percent of preoperative chest radiography revealed abnormalities but only two percent had an impact on treatment plans. They advocated chest radiography be ordered for patients suspected to have cardiopulmonary pathologies, those with findings on exam, elderly and those undergoing thoracic surgery.

Twenty-five chest radiography (6.4%) were obtained in a routine manner in our study. None of these 'routine' X-rays contributed into diagnosis or treatment. These results are consistent with literature data. As the contribution of routine chest radiography into decision making is negligible, we suggest that routine chest radiography should not be ordered.

In our study, 213 chest radiography (55.0%) were ordered to rule out life-threatening pathologies. Only 13 (6.1%) of these resulted in a change in treatment plan. There were six cases with pneumothorax of whom two were confirmed with chest radiography. One fourth of chest radiography ordered to verify the diagnosis were affected by chest radiography. Findings relating to cardiovascular radiology were mostly pertinent to chronic changes. The clinical diagnoses were clarified via chest radiography interpretation in acute pulmonary edema and CHF. We suggest chest radiography be ordered in these patients. Our findings also indicate that for patients with NSCP the yield of chest radiography would be too small and hence may not be needed.

Conclusion

Plain chest radiography may contribute in the diagnosis and treatment of ED patients with dyspnea who were suspected to have pneumonia, pneumothorax, chronic obstructive pulmonary disease, lung cancer and congestive heart disease. The yield of the technique will be small in patients with uncomp-

licated asthma or other pulmonary diseases and cardiac problems.

Cost-effective and rational utilization of chest radiography in ED has been a major corcern. Further large scale randomized and blinded studies are needed for more conclusive data.

References

1. Schringer D. Usefullness of diagnostic testing in ED. In: Cantrill S, Karas S, editors. Cost-effective diagnostic testing in emergency medicine. Dallas: ACEP; 1994. p. 11-5.

2. Besim A, Aydıngöz Ü, Akbulut H. Radyolojik tanı el kitabı. 2nd ed. Ankara: Türkiye Klinikleri; 1992. p. 27-81.

3. Reisdorf E, Schwartz T. Introduction to emergency radiology. In: Schwartz T, Reisdorf E, editors. Emergency radiology. 1st ed. New York: McGraw Hill; 2000. p. 1-10.

4. Clinton JE, Yaron M, Tsai SH. Chest radiography in the emergency department. *Ann Emerg Med* 1986;15:254-6.

5. Emerman CL, Cydulka RK. Evaluation of high-yield criteria for chest radiography in acute exacerbation of chronic obstructive pulmonary disease. *Ann Emerg Med* 1993;22:680-4.

6. Tsai TW, Gallagher EJ, Lombardi G, Gennis P, Carter W. Guidelines for the selective ordering of admission chest radiography in adult obstructive airway disease. *Ann Emerg Med* 1993;22:1854-8.

7. Sherman S, Skoney JA, Ravikrishnan KP. Routine chest radiographs in exacerbations of chronic obstructive pulmonary disease. Diagnostic value. *Arch Intern Med* 1989;149:2493-6.

8. Aronson S, Gennis P, Kelly D, Landis R, Gallagher J. The value of routine admission chest radiographs in adult asthmatics. *Ann Emerg Med* 1989;18:1206-8.

9. Findley LJ, Sahn SA. The value of chest roentgenograms in acute asthma in adults. *Chest* 1981;80:535-6.

10. Heckerling PS, Tape TG, Wigton RS, Hissong KK, Leikin JB, Ornato JP, et al. Clinical prediction rule for pulmonary infiltrates. *Ann Intern Med* 1990;113:664-70.

11. Emerman CL, Dawson N, Speroff T, Siciliano C, Effron D, Rashad F, et al. Comparison of physician judgment and decision aids for ordering chest radiographs for pneumonia in outpatients. *Ann Emerg Med* 1991;20:1215-9.

12. Hubbell FA, Greenfield S, Tyler JL, Chetty K, Wyle FA. The impact of routine admission chest x-ray films on patient care. *N Engl J Med* 1985;312:209-13.

13. Russell NJ, Pantin CF, Emerson PA, Crichton NJ. The role of chest radiography in patients presenting with anterior chest pain to the Accident & Emergency Department. *J R Soc Med* 1988;81:626-8.

14. Templeton PA, McCallion WA, McKinney LA, Wilson HK. Chest pain in the accident and emergency department: is chest radiography worthwhile? *Arch Emerg Med* 1991;8:97-101.

15. Benacerraf BR, McLoud TC, Rhea JT, Tritschler V, Libby P. An assessment of the contribution of chest radiography in outpatients with acute chest complaints: a prospective study. *Radiology* 1981;138:293-9.

16. Tape TG, Mushlin AI. The utility of routine chest radiographs. *Ann Intern Med* 1986;104:663-70.