THE VALUE OF ROUTINE PORTABLE CHEST RADIOGRAPH OF PATIENTS IN INTENSIVE CARE UNIT (ICU)

BY

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To

My loving wife, Pn Razana Ibrahim,

My lovely children, Nurul Izzati, Muhammad Irfan,

Nurul Najwa and Muhammad Aliff Najmi

For true patience all the way throughout my long mastership.

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ABBREVIATIONS

ABG	Arterial blood gas
CI	Confidence Interval
CXR	Chest radiographs
CVP	Central Venous Pressure
df	degree of freedom
HUSM	Hospital Universiti Sains Malaysia
ICU	Intensive Care Unit
IVC	Inferior vena cava
PACS	Picture Archiving Communication System
PICC	Peripherally inserted central catheter
SVC	Superior vena cava

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ABSTRAK

Tajuk: Penggunaan rutin X- ray dada mudah-alih di Unit Rawatan Rapi.

Pengenalan:

Sejak kewujudan Unit Rawatan Rapi untuk pesakit pesakit kritikal, terdapat dua aliran yang berbeza dalam penggunaan CXR mudah-alih di pusat tersebut. Satu aliran berpendapat penggunaan CXR mudah-alih rutin dapat mengenalpasti keabnormalan yang tidak dijangka dengan pemeriksaan fizikal. Pada pihak yang lain pula berpendapat CXR mudah-alih rutin tidak memberi banyak manafaat kepada pesakit, sebaliknya hanya menambahkan dos radiasi. Setakat ini dua piawai penjagaan dipakai, satu yang menggunakan protokol rutin dan satu lagi menggunakan protokol berasaskan pemeriksaan klinikal. Di Hospital Universiti Sains Malaysia (HUSM), terdapat pakar di Unit Rawatan Rapi yang mempraktikkan CXR rutin dengan sedikit modifikasi, manakala sebahagian yang lain menggunakan protokol berasaskan pemeriksaan klinikal. Penyelidikan ini bertujuan untuk menentukan tahap keberkesanan pengenalpastian dan tahap pengaruh kepada cara rawatan oleh CXR mudah-alih rutin di Unit Rawatan Rapi HUSM.

Metodologi:

Kajian keratan rentas ini dijalankan selama enam bulan dari bulan Oktober 2006 hingga Mac 2007. Pada jangkamasa ini sebanyak 1016 filem CXR dari Unit Rawatan Rapi dibuat dan 501 filem CXR dianalisa. Filem filem CXR tersebut dibahagikan kepada dua kumpulan iaitu kumpulan rutin dan tidak rutin. Segala data terhasil direkodkan. Imej imej tersebut dilaporkan oleh pakar radiologi pelatih menggunakan "GE Pathspeed Diagnostic Workstation" di jabatan radiologi. Penyelidikan ini telah memperolehi kelulusan daripada Jawatankuasa Penyelidikan dan Etika Universiti.

Keputusan:

Keputusan kami menunjukkan 55 (17.3 %) filem x-ray menunjukkan lesi baru atau keabnormalan signifikan berbanding dengan 132 (72.1 %) dalam kumpulan tidak rutin. Perbezaan yang ketara wujud dalam mengenalpasti lesi baru dalam kumpulan rutin berbanding kumpulan tidak rutin dengan nilai p kurang dari 0.001.

Pada kajian pengenalpastian lesi baru yang mengakibatkan perubahan dalam perawatan, nilai yang lebih tinggi diperhatikan dalam kumpulan tidak rutin, 68.9 % berbanding 9.4 % dengan nilai p kurang dari 0.001.

Kesimpulan:

Kumpulan tidak rutin mempunyai kebolehan pengesanan lesi dan efikasi terapeutik yang tinggi berbanding rutin x-ray. Penggunaan protokol rutin didapati tidak berpadanan dengan kos dan akan menyebabkan penambahan radiasi kepada pesakit dengan hanya faedah yang sedikit sekali.

ABSTRACT

Title: The value of routine portable chest radiograph of patients in Intensive Care Unit (ICU).

Introduction:

Since the advent of ICU set up, there has been two schools of thought regarding the usage of routine portable chest radiograph in critically ill patients. One school of thought says that routine portable CXR will give a significant number of unsuspected findings while the other claimed that it just increased radiation dose to the patient and little benefits obtained. At present, two standards of care have evolved, one using routine CXR and the other using clinically indicated CXR. In Hospital Universiti Sains Malaysia (HUSM), some of our ICU physicians practised routine CXR particularly in cardiopulmonary disease with some modification while some of them requested CXR when clinically indicated. Our study aim is to determine the diagnostic and therapeutic efficacy of routine chest radiographs in ICU HUSM.

Methodology:

This study was a cross sectional design conducted in HUSM starting from October 2006 till March 2007. 1016 CXRs were obtained within the study period and 501 portable CXRs were included in this study. The CXR were analysed and divided into routine and non routine groups. The CXR findings were recorded. The images were reviewed by a trainee radiologist using GE Pathspeed Diagnostic Workstation in the department of radiology. Approval from the Research Board Committee was obtained prior to study.

Results:

Fifty five (17.3 %) CXRs showed new lesions or significant abnormality in routine group, compared with 132 (72.1 %). There was a significant difference of detecting new lesion between routine and non routine with p value of 0.001. The CXR with new findings that resulted in an intervention was significantly higher in non routine compared to the routine groups, 68.9 % and 9.4 % respectively with p value of 0.001.

Conclusion:

The non routine protocol yielded better diagnostic and therapeutic efficacy than routine CXR. The use of routine CXR is not cost effective. It resulted in an increased radiation dose to the patient with only little benefits.

CHAPTER 1:
INTRODUCTION

1 INTRODUCTION

Chest radiographs are one of the most common imaging modalities performed in Intensive Care Unit (ICU). Since the introduction of ICU in this country, there were always two schools of thought regarding the usage of chest radiographs (CXR) either as daily routine or clinical basis. Some authors argued regarding the protocol of daily routine CXR in intubated patients by yielded a high prevalence of unsuspected findings (Hall *et al.*, 1991). On the other hand, another author claimed that this protocol were not cost effective and gave extra radiation to the patient and ICU staff as a whole. As a result of this differences, two standard of care has developed, one practising daily routine CXR and the other using clinically indicated CXR as a standard protocol.

A consensus opinion of the American College of Radiology Expert Panel stated that daily routine chest radiograph were indicated in patients with acute cardiopulmonary problems and in patients receiving mechanical ventilation.

There were as many as 12000 routine CXR ordered in the ICU of an academic medical center annually (Hall *et al.*, 1991). It was obvious that most of these CXR were not justified clinically. Substantial saving could be saved by limiting the number of such studies (Graat *et al.*, 2006).

In HUSM setting, some ICU physicians were still using the strategy called routine CXR in their daily work with some modification. For example instead of using the protocol of daily routine they modified to a routine CXR on every other day. However on the other hand there were also physicians who used non routine CXR as a standard care. So far as researcher is concerned, there is no such study to compare the efficacy of routine CXR against the non routine in malaysia in general and HUSM in particular. The purpose of this study is to determine whether the standard of care in HUSM yielded better diagnostic findings and influenced the patient's management.

CHAPTER 2: LITERATURE REVIEW

2 LITERATURE REVIEW

2.1 Normal anatomy of thorax

The thorax or chest is the region of the body between the neck and abdomen. It is flattened in the front and behind but rounded at the sides. The thoracic cage is formed by the vertebral column behind, the ribs and intercostal spaces on either sides and sternum and costal cartilages in front. Superiorly the thorax communicates with the neck through the thoracic inlet, and inferiorly it is separated with the abdomen by the diaphragms. The thoracic cage protects the heart and lungs and afford the attachment for the muscles of the thorax, upper extremity, abdomen, and back.

The cavity of the thorax is divided into a median partition, called mediastinum, and the laterally placed pleura and lungs. The lungs are covered by a thin membrane called visceral pleura which passes from each lung at its root to the inner surface of the chest wall. In this manner, two membrane sacs called pleural cavities are formed on each side of the thorax, between the lung and the thoracic walls.

The mediastinum extends superiorly to the thoracic inlet and the root of the neck and inferiorly to the to the diaphragm. It extends anteriorly to the sternum and posteriorly to the twelve thoracic vertebrae of the vertebral column. It contained the

thymus, heart and large blood vessels, trachea, oesophagus, thoracic duct and lymph nodes, vagus and phrenic nerves and the sympathetic trunks. The mediastinum is divided into four parts namely superior, anterior, middle and posterior. The superior mediastinum is bounded in front by the manubrium sterni and behind by the first four thoracic vertebrae. Inferior mediastinum is bounded in front by the body of sternum and behind by the lower eight thoracic vertebrae.

2.2 Normal chest radiograph

The heart and great vessels form a characteristic contour on frontal chest radiograph. The right side of the mediastinal contour is formed from above downward by the brachiocephalic vein and the superior vena cava. The SVC formed the shallow angle with the right atrium, which formed the right heart border. The terminal part of IVC is seen just medial to right cardiophrenic angle. Occasionally a fibrofatty pad displaced right pleura laterally, obscuring the cardiophrenic angle.

The left side of of the mediastinal contour is formed by the composite shadow of the subclavian vessels superiorly. The artery is lower and actually formed the contour. Just below it, the aortic prominence known as "aortic knuckle" is formed by posterior part of arch of aorta. It may be indinstint in young people but usually prominent in elderly especially in cases of unfolding of aorta. Sometimes a small 'nipple' may be seen projecting from the aortic knuckle which is caused by the left

superior intercostal veins. In older people, the descending of aorta is visible on the left. Below the aortic knuckle is an air space called an aortopulmonary window.

Below the aortopulmonary window is the main pulmonary artery, which has a straight upper border and below this is the left ventricle. The left atrial appendages lies embedded in fat below the left pulmonary artery. The left cardiophrenic angle is not as sharp as on the right side. On deep inspiration, air-filled lung is seen under the apex of the ventricle. Occasionally, a fat pad is present in the left cardiophrenic angle.

The pulmonary arteries and veins formed the densities of the hila on the frontal chest radiograph. The fissures of the lung can only be seen if tangential to the X ray beam and seldom seen on entire length because of its curvature shaped. The trachea is seen as a midline translucency with a slight inclination to the right in its lower half. The right paratracheal stripe is formed by the right tracheal wall and the pleura outline on both sides by air. The bronchi contributes very little to the lung marking seen on plain films.

2.3 The significant changes of lung and mediastinum pathology

2.3.1 Atelectasis

The term atelectasis is derived from the Greek words *ateles* and *ektasis*, which mean incomplete expansion. Atelectasis is defined as diminished volume affecting all or part of a lung. Pulmonary atelectasis is one of the most commonly encountered abnormalities in chest radiology findings. Atelectasis is a common finding in critically ill patient and represent areas of non-aerated lung. Retained secretion is the most common cause. The extent can vary from linear bands of subsegmental atelectasis through to more extensive opacification to lobar collapse. Air bronchogram may be visible. Atelectasis is usually basal with a particular predominance in the left lower lobe following cardiac surgery.

Recognizing an abnormality due to atelectasis on chest X-ray films is crucial to understanding the underlying pathology. Several types of atelectasis exist; each has a characteristic radiographic pattern and etiology. Atelectasis is divided physiologically into obstructive and nonobstructive causes. Obstructive atelectasis is the most common type and resulted from reabsorption of gas from the alveoli when communication between the trachea and alveoli is obstructed. Non obstructive atelectasis can be caused by loss of contact between the parietal and visceral pleura, compression, loss of surfactant, and replacement of parenchymal tissues by scarring or infiltrative diseases.