

Assessment of Limited Chest X-ray Technique in Postcardiac Surgery Management

Abstract

Objectives: The objective of this study is to investigate the safety of elimination of chest radiography in the postcardiac surgery Intensive Care Unit (ICU). **Methods and Design:** We compared patients in two different groups of routine CXR (RCXR) and limited CXR (LCXR) and their diagnostic and therapeutic outcome in a University hospital-based single center from 2014 to 2016. 3 CXR in the RCXR group and 1 CXR in the limited group was performed, in addition to on-demand criteria. **Measurement and Main Results:** A total of 978 samples were acceptable for analysis which 55.21% of RCXR and 59.50% of LCXR were male patients. In total, 523 abnormalities in RCXR group and 154 occasions in LCXR group resulted in 26.73% diagnostic efficacy for RCXRs and 28.57% for LCXR. From 1956 CXR that was taken in RCXR group, 72 occasions required intervention (3.68%) and 84 cases out of 539 (15.58%) LCXR needed an action to therapy. This means a 14.40% in RCXRs' abnormalities and 56.00% of LCXRs' abnormalities were accompanied with some interventions. **Conclusions:** Abolishing routine CXR in the ICUs would not be harmful for the patients, and it can be managed based on their clinical status and other safer imaging techniques.

Keywords: Cardiac surgery Intensive Care Unit, chest X-ray, Echocardiography

Introduction

Chest X-rays (CXRs) are performed routinely after most of the invasive procedure, so the Intensive Care Unit (ICU) patients would be among the first candidates for these radiographs. There are many studies searching for a logical answer to this question: whether we should perform the CXR routinely or base on the requirement? It is obvious that there are many advantages in less radiography such as economic benefits for both of patient and hospital, lower exposure to the radiations and less deceptive situations which may mislead the practitioners to unnecessary interventions. However, we cannot deny the possibility of losing an early detection of an issue which may lengthen the ICU stay and may result in higher mortality.

Since 2006 most of the papers suggested elimination of CXRs in ICU.^[1] However, most of these articles refer to a general ICU.^[2,3] There were also some studies which had eliminated partially the CXRs in cardiac ICUs;^[4] One of these studies on 214 patients suggested that clinical assessment is not assuring, though their restricted strategy for obtaining CXR

seemed to be safe for most of their patient. There is also a trending sight for replacing different ultrasonography and echocardiography.^[5] We aimed to compare our patients in two different group of routine chest radiography (RCXR) and limited chest radiography (LCXR). Our routine criteria, same as other papers consisted of three CXR: One on the admission to the ICU, another whenever the drains were pull out and the third one was performed on the discharge from ICU. In our limited group, we just obtained CXR whenever the clinical examinations and echocardiography indicated a requirement for intervention; in other word, we totally abandoned CXRs in the ICU and we only obtained a single CXR before discharge from the ward. To the knowledge of researchers, this is the first article which followed up this large society for a long-term period.

Methods

The current study was performed between September 2014 and January 2016 in the university-based hospital of Imam. The patients were divided into two groups of routine CXR and limited CXR. In the

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Access this article online

Website: www.annals.in

DOI: 10.4103/0971-9784.197829

Quick Response Code:



How to cite this article: Salehi M, Saberi K, Rahmanian M, Bakhshandeh AR, Sharifi S. Assessment of limited chest X-ray technique in postcardiac surgery management. *Ann Card Anaesth* 2017;20:38-41.

Received: May, 2016. **Accepted:** November, 2016.

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routine group, one CXR was obtained at the time that the patient was transferred to the ICU, another CXR was performed after the drains were pulled out and finally, the third CXR was performed at the time the patient was going to discharge to the ward.

In the limited CXR group, the patient was examined clinically by heart and lung auscultation and performing echocardiography if needed. In addition, central venous pressure, invasive arterial blood pressure, an electrocardiography monitoring were obtained constantly for cardiac status interpretation. Other investigations consisted of urinary output, body temperature which was recorded precisely. If any problem requiring intervention was diagnosed, a CXR was obtained from the patient before any intervention to guide the therapy and confirm the clinical diagnosis. Furthermore, CXR was accessible whenever needed. In this group, we only obtained a single CXR before discharge from the ward.

We had excluded the patients required intra-aortic balloon pumps, redo operations, the patients which was suspicious to a left-over of gauzes or other external substances, the patients under 2-year-old, an ICU stay of more than 48 h and expire in the first 48 hours.

Just at the admission to the ICU, the patients were divided alternatively. Of note, the research group was not aware of the groups; the study was double-blinded, and all the investigation and invasive actions were done equally for both groups. From our 1150 patients, 978 samples were acceptable for our analysis and the other 172 samples were excluded due to our exclusion criteria.

Results

From our 1150 patients, 978 samples were acceptable for analysis in which their characteristics are shown in Table 1. In routine CXR (RCXR) group, we had seen a mean age of 59 and limited CXR (LCXR) group had an average age of 61. 55.21% of RCXR and 59.50% of LCXR were male patients. The majority of the patients in both groups of RCXR (223) and LCXR (198) underwent coronary artery

bypass graft (CABG); a combination of valve surgery and CABG was the second frequent surgery with 134 patients in RCXR group and 151 in LCXRs. Further, 96 RCXRs' and 110 LCXRs' patient had taken a valve surgery; other detailed information is reported in Table 1.

Overall 1956 CXRs were obtained in RCXR group, and 539 CXRs were LCXR groups' share. A total of 523 abnormalities in RCXR group and 154 occasions in LCXR group resulted in 26.73% diagnostic efficacy for RCXRs and 28.57% for LCXR. Among the abnormalities that are listed in Table 2 pleural effusion was the most frequent in RCXR group, along with pulmonary congestion and atelectasis; on the other hand, pulmonary congestion was the most pervasive in LCXR group. In both groups, we had a low incidence of wide mediastinum; however, we did not face pneumothorax in the LCXR group.

From 1956 CXR that was taken in RCXR group, 72 occasions required intervention (3.68%) and 84 cases out of 539 (15.58%) LCXR needed an action to therapy. This means a 14.40% (72 out of 500) in RCXRs' abnormalities and 56.00% (84 out of 150) of LCXRs' abnormalities were accompanied with some interventions that are listed in Table 3. There were only 25 patients in these 16 months who came back for further interventions that 11 of them were in RCXR group and the other 14 were in LCXR group; this was mostly because of wound infection, sternal dehiscence, and cardiac reoperations. Our result indicated that the diagnostic efficacy in the LCXR would be the same using echocardiography and all the complications that were accepted by echocardiography was also confirmed by CXR.

Discussion

As it was mentioned, we had a diagnostic efficacy of 26.73% in RCXR and 28.57% in LCXR. We had faced a therapeutic efficacy of 3.68%, and this was surprisingly 15.58% in LCXR. However, our RCXR group had a therapeutic efficacy same as the majority of studies in ICUs,^[6,7] the percentage was really notable in LCXR. As it was explained in our method, we utilized the CXR for confirmation of any signs that had been detected clinically; we think that is because we come across such therapeutic efficacy in LCXRs' patients. Previous studies suggested a poor association of CXR and abnormality detection; this was also accepted in our RCXR group, but was contradicted by the LCXR group; this result was a confirmation to our key concept of elimination of CXRs and supersedes it with clinical observation and echocardiography. This finding was in line with recent study suggesting a reduction of CXRs by using point-of-care ultrasonography techniques.^[8-10] A literature review shows different performance such as clarification of perioperative hemodynamics,^[11] adding diagnostic values,^[12] demonstration of cardiac dysfunctions and abnormalities^[13] for echocardiography which makes a powerful tool for diagnosis.

Table 1: Patients' characteristics

	Routine CXR	Limited CXR
Age	59±12	61±10
Male	270	291
ICU stay	1 (1-2)	1 (1-2)
Hospital stay	5 (4-8)	5 (4-8)
Type of surgery		
CABG	223	198
Valve surgery	96	110
CABG + valve	134	151
Others	36	30
Total	489	489

Patients' characteristics. ICU: Intensive Care Unit, CXR: Chest X-ray, CABG: Coronary artery bypass graft

Table 2: Number of abnormalities in the CXRs and change in therapy

Number of CXR	Routine CXR		Limited CXR	
	1956		539	
	Formed	Therapy	Formed	Therapy
Pleural effusion	300	25	50	30
Pneumothorax	25	4	10	5
Pulmonary congestion	60	40	56	45
Widened mediastinum	30	3	-	4
Atelectasis	58	-	20	-
Consolidation	50	-	18	-

Number of abnormalities in the CXRs and change in therapy. CXRs: Chest X-rays

Table 3: Interventions and abnormalities in CXR

	Routine CXR (%)	Limited CXR (%)
CXR without abnormality	1456/1956 (74.43)	389/539 (72.17)
CXR with abnormality	500/1956 (25.56)	150/539 (27.83)
CXR with intervention	72/1956 (3.68)	84/539 (15.58)
Intervention to abnormal CXR ratio	72/500 (14.4)	84/150 (56)

Interventions and abnormalities in CXR. CXR: Chest X-ray

In one study on the off-pump CABG patients, Forouzannia *et al.* found in their 1 month follow-up that there are no changes in patients' status after reduction of CXRs; they suggested an on demand CXR for these patients.^[14] Although our data showed a minimum difference between diagnostic efficacy. There was an ostentatious difference between therapeutic efficacy of LCXR and that of RCXR (28.57% vs. 26.73% for diagnostic and 15.58% vs. 3.68% for therapeutic efficacy). This finding was same as the other studies in the general ICUs.^[15,16]

In this study, we found that the CXR findings did not necessarily lead to an alteration in therapeutic strategies; this was also in line with another study.^[17-19] Another study from Sy *et al.* concluded that an enhancement in staffs' education and determination of appropriate indication of CXRs for them resulted in 26% reduction.^[20]

Despite this fact that most of the studies that support the idea of using routine CXRs are out of date, there are yet some new researches that may encourage the practitioners to use CXRs more often: Neves *et al.* reported a coronary calcification seen in the CXR;^[21] such findings can alert the medical staffs about the danger of stroke and importance of early detection.^[21] In our research, we emphasize on importance of using other paraclinical instruments, like angiography, which in this case would be sufficient for patients' safety. Obviously, angiography is a routine imaging before the cardiac surgeries. The priority of angiography compare to CXR was also suggested by other papers.^[22] A study on minimal invasive cardiac procedures such as port access, ministernotomy or bilateral video-assisted thoracoscopy concluded that because of

an increase in diagnosis efficacy, routine CXR would be necessary.^[23] However, they did not recognize the helpful guidance of other imaging standards, like echocardiography.

Conclusion

As our data indicated, abolishing routine CXR in the ICUs would not be harmful for the patients, and it can be managed based on their clinical status and other safer imaging techniques. The most important restriction of our study was being in a single center. Further, we could not perform the other imaging technics according to an accurate plan. Although there are some reliable studies on using ultrasonography for different situations,^[24,25] there are no guidelines at the time. We suggest more studies to be done for finding a reasonable protocol of ultrasonography and other imaging technics in the ICU. We also recommend further studies for finding the economical and time consideration of echocardiography compare to CXR.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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