ANALYSIS OF IMAGE QUALITY OF PEDIATRIC CHEST RADIOGRAPHY IN THE NEONATAL INTENSIVE CARE UNIT (NICU) OF HOSPITAL UNIVERSITI SAINS MALAYSIA (HUSM)

DR MOHD FIRDAUS BIN MOHD AWAL

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Completing this thesis would not be possible without Dr Khairil Amir Sayuti, Radiology Head of the Department, as well as all the lecturers and radiographers.

Finally, I would only be here for my family. Thank you, my family, for your unconditional love and support.

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Abbreviation:

NICU Neonatal intensive care unit

VGAS Visual grading assessment score.

HUSM Hospital universiti sains Malaysia.

kVP Kilovoltage peak

mAS milliampere-seconds.

CXR Chest xray

BMI Body mass Index

SD Standard Deviation

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Abstrak

Latar belakang: Radiografi dada adalah pemeriksaan yang paling kerap dilakukan di jabatan radiologi. Adalah penting untuk memastikan kualiti imej radiografi dada yang diperolehi adalah bagus untuk membantu dalam mengdiagnosi penyakit dan mengelakkan insiden pengulangan pemeriksaan radiografi dada. Salah satu cara untuk menganalisa kualiti imej adalah dengan menggunakan pemarkahan skor analisis penggredan visual (VGAS). Faktor lain yang boleh mempengaruhi kualiti radiografi dada ialah kolimasi imej dengan menggunakan skor kolimasi dan berat badan pesakit . Kajian ini bertujuan untuk menganalisia radiografi dada yang dilakukan di unit rawatan rapi neonatal (NICU). Kami menggunakan pemarkahan skor analisis penggredan visual VGAS dan untuk mengkaji korelasi antara skor VGAS, dengan skor kolimasi, berat badan dan jantina.

Kaedah: Kajian keratan rentas ini dilakukan di Hopital Universiti Sains Malaysia**,**
Kubang Kerian, Kelantan. Radiografi dada mudah alih yang dilakukan di unit rawatan rapi neonatal NICU semasa tempoh kajian telah disemak dan dijaringkan mengikut kriteria pemarkahan VGAS dan skor kolimasi. Korelasi antara skor VGAS, skor kolimasi, berat badan dan umur telah diuji menggunakan ujian korelasi Pearson. Korelasi antara skor VGAS di antara jantina lelaki dan perempuan diuji menggunakan One-way ANOVA.

K**eputusan**: Bacaan mean skor VGAS dan skor kolimasi masing-masing adalah 21.66 ±1.54 dan 2.57 ±1.96. Terdapat korelasi negatif yang lemah antara skor kolimasi dan skor VGAS, yang signifikan secara statistik ($r = -0.182$, $p = 0.010$). Terdapat juga signifikan korelasi negatif yang lemah antara umur dan VGAS skor ($r = -0.303$, $p < 0.001$). Walau bagaimanapun terdapat korelasi positif antara berat badan pesakit dan skor VGAS tetapi secara statistik tidak signifikan dan tiada perbezaan skor VGAS yang signifikan antara lelaki dan perempuan ($F(1,195) = 0.669$, $p = 0.414$)

Kesimpulan: Skor VGAS di pusat kajian menunjukkan kualiti cemerlng radiografi dada. Terdapat korelasi yang signifikan secara statistik antara skor VGAS dengan skor kolimasi dan umur pesakit.

Keywords: VGAS scoring, chest radiograph quality analysis, collimation score, body weight.

Abstract

Background: Chest radiography is the commonest radiography examination performed in the radiology department. It is vital to ensure the excellent quality of the chest radiograph performed to aid in diagnosing the clinical condition and to reduce the incidence of the repeated chest radiograph. One of the methods to analyse the quality of the chest radiograph is using a visual grading analysis score (VGAS) scoring. Other factors that affect the quality of the radiograph are image collimation by using collimation score and body weight.

This study aims to analyse the quality of the chest radiographic performed in our centre's neonatal intensive care unit (NICU) using a visual grading analysis score VGAS scoring. We also will study the correlation between VGAS score, collimation score, body weight and gender.

Methods: This cross-sectional study was done at NICU Hospital University Sains Malaysia, Kubang Kerian, Kelantan. A portable chest radiograph performed in the neonatal intensive care unit NICU during the study duration was reviewed and scored according to the VGAS scoring criteria and collimation score. The correlation between VGAS score, collimation score, body weight and age were tested using the Pearson correlation test. Correlation between VGAS score between males and females were tested using One-way ANOVA.

Results: The mean VGAS score and collimation score were 21.66 ± 1.54 and 2.57 ± 1.96 respectively. There is significant weak negative correlation between the collimation score and VGAS score ($r = -0.182$, $p = 0.010$). There is also a significant weak negative correlation between age and VGAS score ($r = -0.303$, $p < 0.001$). However, there was no significant correlation found between weight and VGAS score ($r = 0.035$, $p = 0.630$) and no significant difference in VGAS score between males and females ($F(1,195) = 0.669$, $p = 0.414$).

Conclusion: VGAS scoring for our center shows the excellent quality of chest radiographs. There are statistically significant correlation between VGA score with the collimation score and patient's age.

Keywords: VGAS scoring, chest radiograph quality analysis, collimation score, body weight.

CHAPTER 1: BACKGROUND

1.1. Introduction

Chest radiography is one of the most frequently performed X-ray examinations (Seidenbusch MC et al., 2008; Suliman II et al., 2013; Willis CE et al., 2004). Chest X-rays are a fast way to evaluate respiratory or cardiac diseases. Compared to other techniques like computed tomography, they are easily accessible and inexpensive, and the radiation dose delivered to the patient is relatively low. It is important to acquire appropriate image quality in order to help in the improvement of their diagnostic accuracy, while at the same time reducing the rate of repeated chest x-ray examination due to poor quality and thus increasing unnecessary radiation (Tsapaki et al., 2018).

There are many different elements that can affect the image quality of the portable chest radiograph, among the factors that affect the image contrast are tissue density, collimation and the experience of the radiographic technician. These parameters will influence the quality of the portable chest radiograph. It is important to optimise these parameters in order to establish the required image quality while keeping the dose to the patient as low as reasonably achievable (Khong PL et al., 2013).

One of the methods to assess the quality of chest radiograph images is by using the visual grading assestment score (VGAS) (Guo et al., 2013) which was based on the outline recommended by the European committee (Blanc, D., 1998). In this study, we aim to analyse the portable chest radiography in NICU done in our centre according to the VGAS score.

The previously published chest radiograph quality analysis study in Malaysia was done by Ramanaidu S et al., (2006) in the pediatric age group in 7 major hospitals in Malaysia. The study

compares image quality between utilising VGAS of two different tube potential (kVP), which shows predominantly moderate image quality. However, going through the literature there was no quality audit of chest radiograph performed in the NICU in Malaysia was published. Karami V et al., (2019) published audit regarding radiological protection in the NICU in two centres in Iran. Nitish R. 2020 published an audit of neonatal chest radiograph quality based on the recommendation by the European Committee, which shows significant improvement in chest radiography image quality after an intervention. This shows that it is essential to identify deficiencies and recommend steps for improvement.

It is important to analyse the quality of chest radiograph performed in the neonatal ward as it is one of the commonest procedures performed in the neonatal ward., and no similar analysis was done previously in our centre. It is and important part of quality control of the work done in the radiology department, in order to aid in patient management and reduced the incidence of repeat examination.

1.1. Problem statement

It is important to evaluate the portable radiograph quality in our department and to find factors to improve the quality of the radiograph produced. Poor collimation may result in poor image quality of the chest radiograph. Increased in birth weight may result in poor chest radiograph quality.

1.2 Objectives

1.2.1 General Objective

To assess the quality of portable chest radiographic images done in the neonatal ward using visual grading analysis scoring VGAS in NICU ward.

1.2.2 Specific Objectives

1. To measure the visual grading analysis score VGAS of the portable chest radiograph images in NICU.

2. To determine correlation between visual grading analysis score VGAS of portable chest radiographic image with subject birth weight, age and gender.

3. To determine correlation between visual grading analysis score VGAS of chest radiograph and image collimation scoring.

Research Question

1.What are the percentages of excellent, good, moderate or poor portable radiographic images in HUSM?

2.What is the correlation between VGAS of chest radiography with patient's birth weight, age and gender.

3.Is there any association between VGAS and collimation of image.

Hypothesis

1. Majority of the portable radiographic images were rated as moderate.

2. There is a correlation between VGAS of chest radiography with patient birth weight, age and gender.

3. There is a correlation between VGAS of chest radiography with the image collimation scoring

CHAPTER 2: LITERATURE REVIEW

2.1 Role of portable chest radiograph in NICU

Radiology has an increasing role in modern medicine with a 5% growth per year over the last 25 years (Bosmans et al., 2018). It is a quick method to assess a patient's clinical condition. Due to its increase in usage, it is also contributing to the total annual dose received by the average citizen which is also increasing. Children are particularly susceptible to certain forms of radiation-induced cancer, particularly leukaemia. This radiosensitivity shown by children plus a longer opportunity for expression of an induced malignancy leads to concern about radiation doses to children and highlights the importance of minimizing radiation doses to paediatric patients from medical sources (Bosmans et al., 2018). Diagnostic radiology plays an important role in the assessment and treatment of neonates requiring intensive care, with the most frequent examination being a chest X-ray. Portable radiograph usually performed for intubated patient, patient in medical emergency, neutropenic and infectious patient. According to a study done in 5 hospitals in London shows that chest radiograph constitutes 63.7% of radiological procedure performed on neonate and children up to 1 year of age (Hart D et al., 1996). By optimising the quality of the chest radiography, there are fewer chances for the repeated procedure and reducing the radiation received by the patient (Ching W et al., 2014).

2.2 Evaluation of chest radiograph quality

Image quality can be defined as the attribute of the image that influences the clinician's certainty to perceive the appropriate diagnostic features from the image visually. Quality assurance or quality improvement is defined as proactive actions to enhance the quality of care and services. The most common digital radiographic detectors are computed radiography (CR) and digital

radiography (DR). The important components of radiographic image quality include contrast, dynamic range, spatial resolution, noise, and artefacts (Tompe A et al., 2021).

There are many factors affecting the image quality including the beam energy (kVp), tube current exposure time product (mAs), magnification, focal spot size, detector, collimation, image scatter grid and image processing (Williams Mb et al., 2007)(Saeedi E et al., 2018).

One of the important ways to reduce radiation is by producing good quality chest radiographs, which will improve patient management and reduce the likelihood of repeated examination and reduce the dose received by the patient.

In our study, it is important to evaluate the quality of portable chest radiographs done in our department. One of the criteria for assessment of chest radiographs is the widely used criteria based on the European Communities (Tompe A et al., 2021; Båth M. Månsson L.G. 2014) which assessed image quality based on visualisation of anatomical structure. Based on a study, this criterion is a reliable method for assessing the quality of chest radiographs in the clinical setting (Tesselaar et al., 2021). In our study, we aim to assess the quality of the portable radiography done in the NICU and categorized it based on visual grading analysis score and classify it into excellent, good, moderate and poor category based on Guo et al., 2013.

Guo et al. in 2021 had used VGAS scoring to evaluate image quality for chest radiographs with four different kVp settings. It shows that the overall difference in the mean VGAS between the four groups was statistically significant.

Clinical image quality was assessed by using a visual grading analysis score VGAS technique (Guo et al., 2013) (table1) which was based on the outline recommended by the European committee (Blanc, D., 1998).

Table1: Categories assessed in VGAS scoring. Image evaluation was therefore rated as excellent with a composite score of 18-24 points, good with a score of 14-17 points, moderate with 10-13 points, and poor if the image had less than 10 points(Guo et al., 2013).

Categories:	Point
A) Position and symmetry of the scapula and sternoclavicular joint 1 : Sternoclavicular joint symmetery 2: Scapulas spin out	
B)Lung Fields 1: Within the zone 2: In the zone 3: Take -away	
C)Trachea shows: 1: pipe 2: carina 3: left main bronchus 4: Right main bronchus 5: Segmental bronchus	
D) Mediastinum 1: between one and four thoracic vertebrae 2: most thoracic vertebra 3: All thoracic vertebra 4: sections of the aorta 5: Right cardiac border 6: Left cardiac border	
E) Ribs 1: bone cortex 2: trabecular bone	
F) Chest wall 1: soft tissue 2: fat line 3: breast tissue	
For categories A-F 1 point was given if it was shown and 0 point if they were not displayed.	
G) Noise 1: free of noise (3points) 2: Scarce noise (2 points) 3: Significant noise but did not affect diagnosis (1 points) 4: Obvious noise (0 point) no diagnosis possible.	

2.3 Birth weight.

One of the factors affecting CXR image quality is the amount of tissue mass of the subject, it will affect the radiographic contrast. Radiographic contrast is a fractional difference in the signal or brightness between the structure of interest and its surroundings. Contrast is generated by differential attenuation of X-rays by different tissues. Radiographic contrast is directly proportional to atomic number, density, and tissue thickness. For example, X-ray attenuation is least in air and higher in soft tissues and bone. (Ma, X et al., 2022). One of the indirect measures of evaluating tissue volume is by correlating it with birth weight.

2.4 Collimation

Inappropriate irradiation may be quite obvious when it comes to the incorrect collimation of the image field or incorrect positioning of the infant on the detector or film plate. Unnecessary exposure of the abdomen, arms or head can lead to a substantial increase in radiation dose, mainly due to the irradiation of red bone marrow or abdominal viscera. Effects on the cumulative dose in preterm infants may be quite severe and independent of technical parameters.

Collimation is defined as the confinement of the spatial extent of an X-ray beam that impinges upon the region of interest in the patient and detector. Effective collimation causes a decrease in scattered radiation that reaches the detector. This leads to the improvement of image contrast and noise and increased SNR. It also causes less radiation exposure and a reduction in effective radiation dose to the patient. One of the methods to evaluate collimation for chest radiograph

quality in terms of correct collimation by applying a grading system by Stollfus J et al., (2015) (table 2). This scoring is based on visualization of extra thoracic anatomical structure (figure 1).

Table 2: Collimation scoring criteria. The image quality in terms of correct collimation was graded arbitrarily as follows: 0 points = optimal image quality; 1–2 points = slightly reduced; 3–4 = moderately reduced; 5–6 = markedly reduced; and >7 points = severely reduced(MD. Cohen et al., 2012).

A) Inappropriate exposure of abdominal viscera was assumed when the caudal imaging field extended below the level of L1/2 vertebra	1 point
B) Exposure of the cranial structures included more than the tip of mandible	1 point
C) Exposure of the arms when diametaphyseal junction of the proximal humerus came in the field of view:	
1:Diaphyseal humerus	1 point
2:Entire humerus	2 point
3:Part of forearm	1 point
4:Entire forearm	2 points
5:Hand	1 point

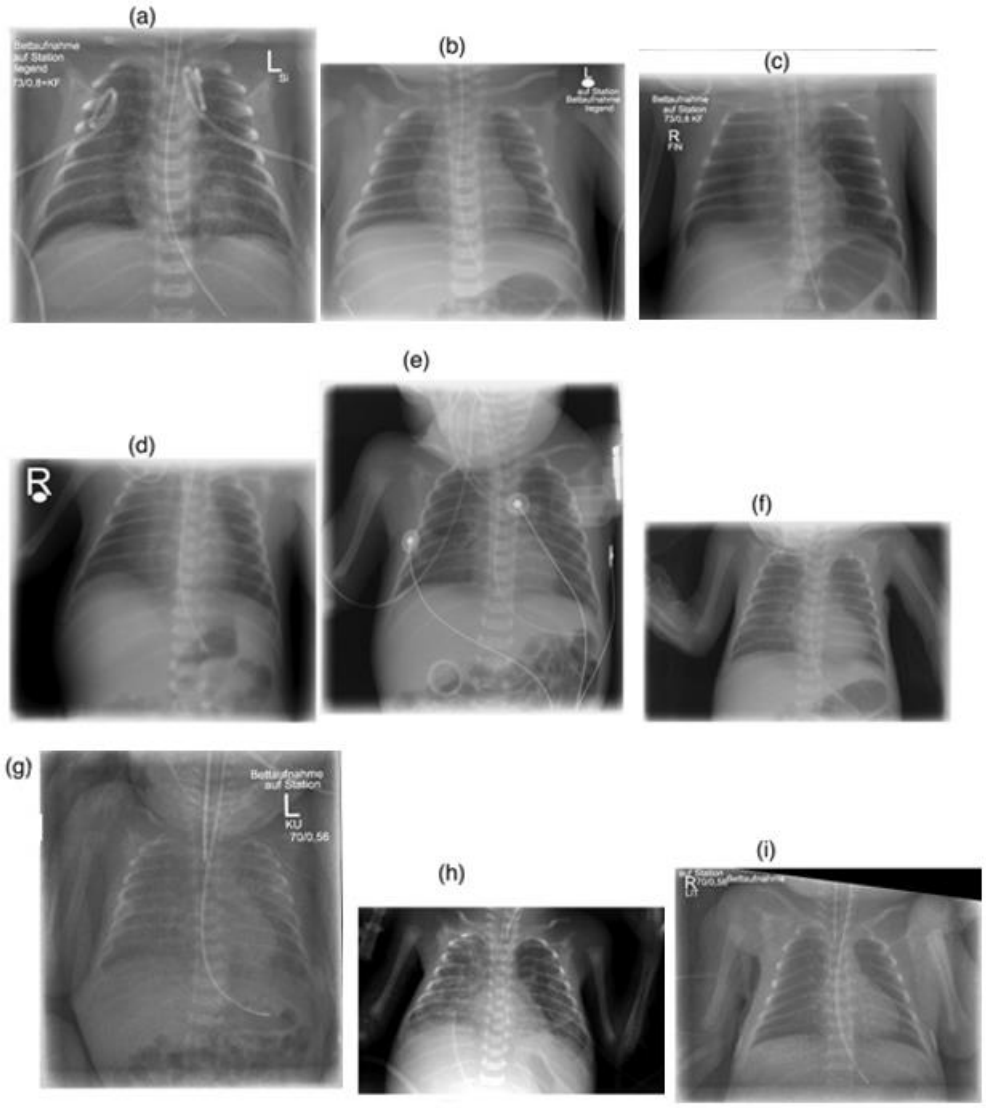

Figure 1: Example of collimation scoring, (a) (0 points): optimal collimation; (b) (1 point) and (c) (2 points): slightly reduced image quality due to exposure of the proximal marrow cavity of the left humerus; (d) (3 points) and (e) (4 points): moderately reduced image quality with exposure of the entire right humerus and part of the forearm; (f) (5 points) and (g) (6 points): markedly reduced image quality in a case showing the entire humerus on both sides and part of left hand; (h) (7 points; and (i) (8 points): severely reduced quality observed in two cases that exposed multiple extra-thoracic structure

2.5. Conceptual framework

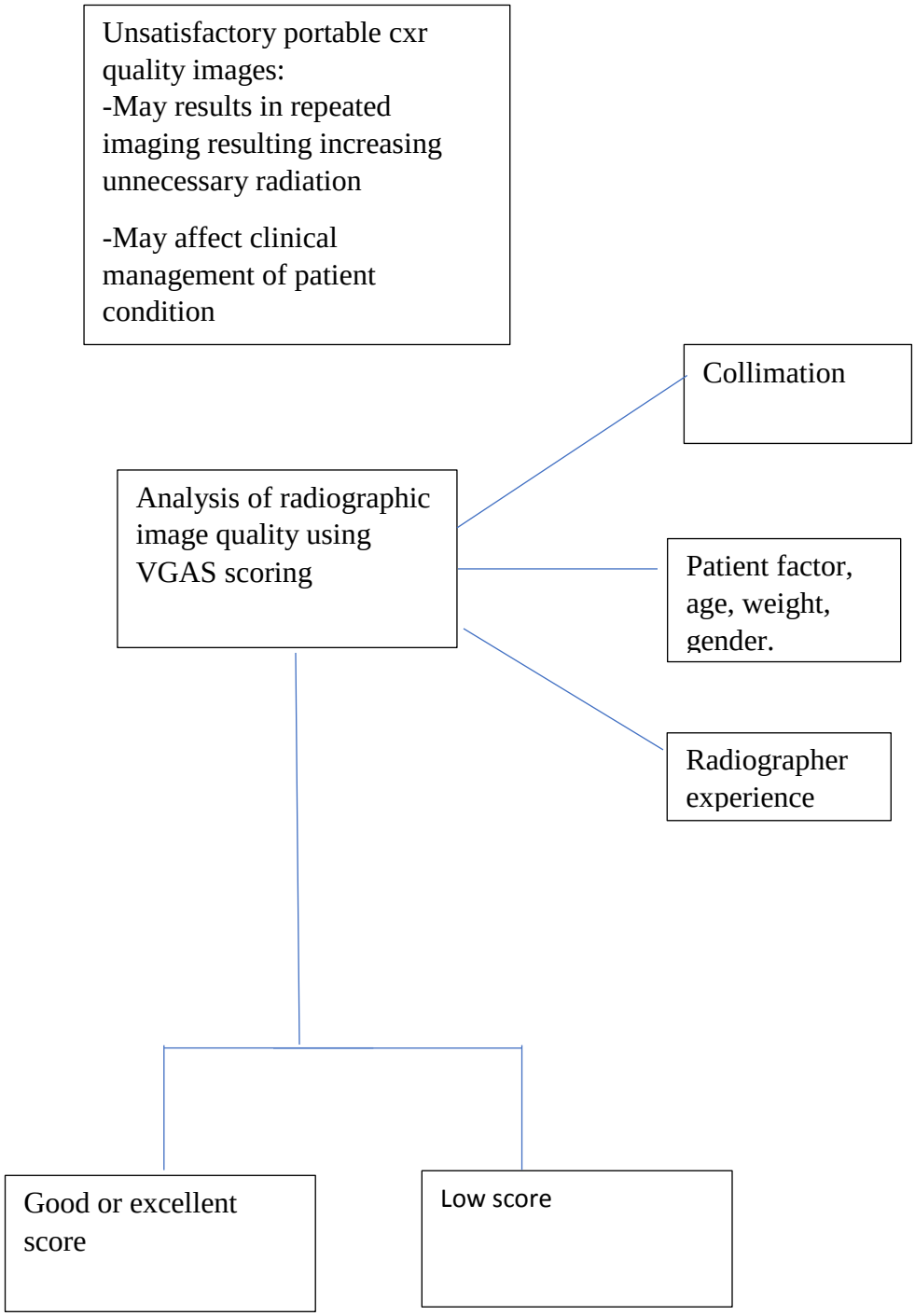

Figure 2: Conceptual framework

2.6. Rationale of the study

This study aims to evaluate the image quality of portable radiography produced in the Radiology department HUSM and to determine whether there is a correlation between VGAS scoring, collimation and birth weight. If this relation is identified, then further optimisation steps could be taken in the future.

CHAPTER 3: METHODOLOGY

Cross sectional study of the chest radiography done in the neonatal ward from 1st January 2022 until 28th February 2022. Image was then analysed based on the quality criteria:

3.1. Study Design

This study design was a retrospective cross-sectional study using secondary data conducted in department of Radiology, Hospital Universiti Sains Malaysia from 1st January 2022 until 28th February 2022.

3.2. Study Location and Duration

Study was conducted in Hospital Universiti Sains Malaysia, of portable chest radiography done in neonatal intensive care unit (NICU).

Study duration was conducted for portable chest radiograph perform in NICU from 1st January 2022 until 28th February 2022.

3.3. Study population and sample.

1. Reference population – Patient admitted in the NICU ward in HUSM during study duration.

2. Source population – Patients admitted in the NICU ward in HUSM who underwent portable chest radiography.

3. Sampling frame - Patients admitted in the NICU ward in HUSM who underwent portable chest radiography from 1st of January 2022 till 28th February 2022. Based on inclusion and exclusion criteria.

3.4. Sampling technique.

Convenience sampling method was applied. A total of 193 chest radiograph done in the NICU ward from from 1st of January 2022 till 28th February 2022. Based on inclusion and exclusion criteria were enrolled in the study.

3.5. Inclusion criteria:

All portable chest radiographic image done in the neonatal ward for neonatal patient during period of study 1st January 2022 until 28th February 2022.

Chest radiograph of patient up to 1 month of age.

Radiography image contain information on patient data (age, birthweight, sex).

3.6. Exclusion criteria

Exclusion criteria:

Pathology which obscured VGAS and collimation scoring criteria is excluded.

Chest radiograph that has undergo post processing collimation is excluded.

3.7 Sample Size Calculation

Sample Size Estimation

3.7.1. Objective 1

Objective: To determine the mean of visual grading analysis score (VGAS) of the portable chest radiograph images in NICU ward of HUSM.

Method: We applied the Single Mean Formula using Sample Size Calculator by Arifin, W. N. (2021) to estimate our sample size. Details of the formula is listed below:

- Standard deviation (σ) of VGAS = 6.71 (Hui G, *et al* (2013))
- Precision (Δ) = 1.00
- Confidence level 100(1 - α): 95%
- Number of sample size (n) = 173
- Drop-out rate = 10 %
- Total sample size = **193**

3.7.2 Objective 2

Objective: To determine correlation between visual grading analysis score (VGAS) of portable chest radiographic image with birth weight.

Method: We applied the 2 means - Hypothesis Testing Formula using Sample Size Calculator by Arifin, W. N. (2022) with power of study: 80%, α as 0.05 and expected drop-out rate was 10% to estimate our sample size. The proportions are explained as below.

- Standard deviation (σ) of age and VGAS: 7.21 (Hui G, *et al* (2013))
- Expected difference = 4
- Sample size, n = 52 and Sample size (with 10% dropout), ndrop = 58
- Total Sample size, n = **116**

3.7.3Objective 3

Objective: To determine correlation between visual grading analysis score (VSAG) of chest radiograph and image collimation.

Method: We applied the 2 means - Hypothesis Testing Formula using Sample Size Calculator by Arifin, W. N. (2022) with power of study: 80%, α as 0.05 and expected drop-out rate was 10% to estimate our sample size. The estimation is explained as below.

- Standard deviation (σ): 1.40 (Stollfuss J, *et al* (2015))
- Expected difference = 0.5
- Sample size, n = 31 and Sample size (with 10% dropout), ndrop = 35
- Total Sample size, n = **70**

3.7.4 Final Sample Size

The final total sample size for our study is **193 samples**.

Reference for Sample Size Calculation:

Arifin, W. N. (2022). Sample size calculator (web). Retrieved from http://wnarifin.github.io

3.8. Research tool:

1. Picture Archive Communication System (PACS) in Hospital USM (PACS

Universal Viewer Version 5.0 SP6)

This software application is used to stored data containing the portable chest radiographic data used in this study.

2. GE- centricity PACS viewer on greyscale BARCO display with 2

Megapixels resolution (1600 x 1200).

This monitor display is used when assessing the chest x-ray to provide optimal and standardised display.

3.9 Variable definition

3.9.1 VGAS scoring criteria, is defined as a scoring criterion used to analyse the quality of chest radiograph (Table 3).

Table 3: Shows example of VGAS scoring system. For categories A-F 1 point was given if it was shown and 0 point if they were not displayed. Category G point is awarded according to the presence of noise in the x-ray, either 3 for free of noise, or 2 for scarce noise, or 1 for significant noise or 0 for obvious noise and diagnosis is not possible. VGAS is calculated by adding total score for categories A to F and category G. Maximum point of VGAS score is 24.

Categories:	Point
A) Position and symmetry of the scapula and sternoclavicular joint	
1 : Sternoclavicular joint symmetery	1
2: Scapulas spin out	1
B)Lung Fields	
1: Within the zone	1
2: In the zone	1
3: Take -away	1
C)Trachea shows:	
1: pipe	1

2: carina 3: left main bronchus 4: Right main bronchus 5: Segmental bronchus	1 1 1 1
D) Mediastinum 1: between one and four thoracic vertebrae 2: most thoracic vertebra 3: All thoracic vertebra 4: sections of the aorta 5: Right cardiac border 6: Left cardiac border	 1 1 1 1 1 1
E) Ribs 1: bone cortex 2: trabecular bone	 1 1
F) Chest wall 1: soft tissue 2: fat line 3: breast tissue	 1 1 1
Total	21
G) Noise (pick one) 1: free of noise (3points) 2: Scarce noise (2 points) 3: Significant noise but did not affect diagnosis (1 points) 4: Obvious noise (0 point) no diagnosis possible.	 3
Final total	24

3.9.2 Collimation score is defined as scoring system for chest radiograph based on how well the collimation is done (Table 4).

Table 4: Collimation scoring criteria.
The image quality in terms of correct collimation was graded arbitrarily as follows: 0 points = optimal image quality; 1–2 points = slightly reduced; 3–4 = moderately reduced; 5–6 = markedly reduced; and >7 points = severely reduced(MD. Cohen et al., 2012).

A)Inappropriate exposure of abdominal viscera was assumed when the caudal imaging field extended below the level of L1/2 vertebra	1 point
B)Exposure of the cranial structures included more than the tip of mandible	1 point
C)Exposure of the arms when diametaphyseal junction of the proximal humerus came in the field of view:	
1:Diaphyseal humerus	1 point
2:Entire humerus	2 point
3:Part of forearm	1 point
4:Entire forearm	2 points
5:Hand	1 point
Total:	

3.9.3 Weight is defined as birth weight recorded in kilograms.

3.9.4 Age is defined as days of life and recorded in number of days.

3.9.5 Gender is recorded as male or female.

3.10 Data collection:

Data collection method:

Cross sectional study of the chest radiography done in the NICU ward in HUSM from 1st January 2022 until 28th February 2022. Chest x-ray Image in Picture Archiving and Communication System (PACS) was then analyzed based on the quality criteria. Patient characteristics, weight and gender was obtained from patient records.

3.11 Image analysis

3. Chest radiographic image performed in the NICU ward during the study duration is PACS was then viewed and analysed using the GE- centricity PACS viewer on greyscale BARCO display

with 2 Megapixels resolution (1600 x 1200). Chest radiograph was then scored according to the (VGAS) score and collimation score.

3.12 Statistical analysis:

All data were analyzed using Statistical Product and Service Solutions (SPSS) for Windows, SPSS Inc.© (Version 26, S PSS Inc., Chicago, IL, USA).

For objective 1, descriptive analysis of the data to determine the mean of visual grading analysis score (VGAS) of portable chest radiography in NICU.

For objective 2, pearson correlation test was used to determine correlation between visual grading analysis score (VGAS) of portable chest radiographic image with birth weight and age. One-way ANOVA is used to determine correlation between VGAS score and gender.

For objective 3, pearson correlation test used to determine correlation between visual grading analysis score (VGAS) of chest radiograph and image collimation.

3.13 Confidentiality and Privacy

The subjects were identified using a unique serial number. No identifiable data was shared publicly. Only research team members can access the data. The data was presented as grouped data and will not identify the responders individually.

Upon completion of the study, all data were stored in CDs, and the database on the computer was erased. The data were retained by the researchers for knowledge purposes only. Neither the name nor any identifying information was used in any publication or presentation resulting from this study.

3.14 Ethical Consideration

The study was approved by Human Research Ethics Committee of Universiti Sains Malaysia Research Ethics Committee of USM JEPeM Code: USM/JEPeM/22110736.

3.15 Study flow chart.

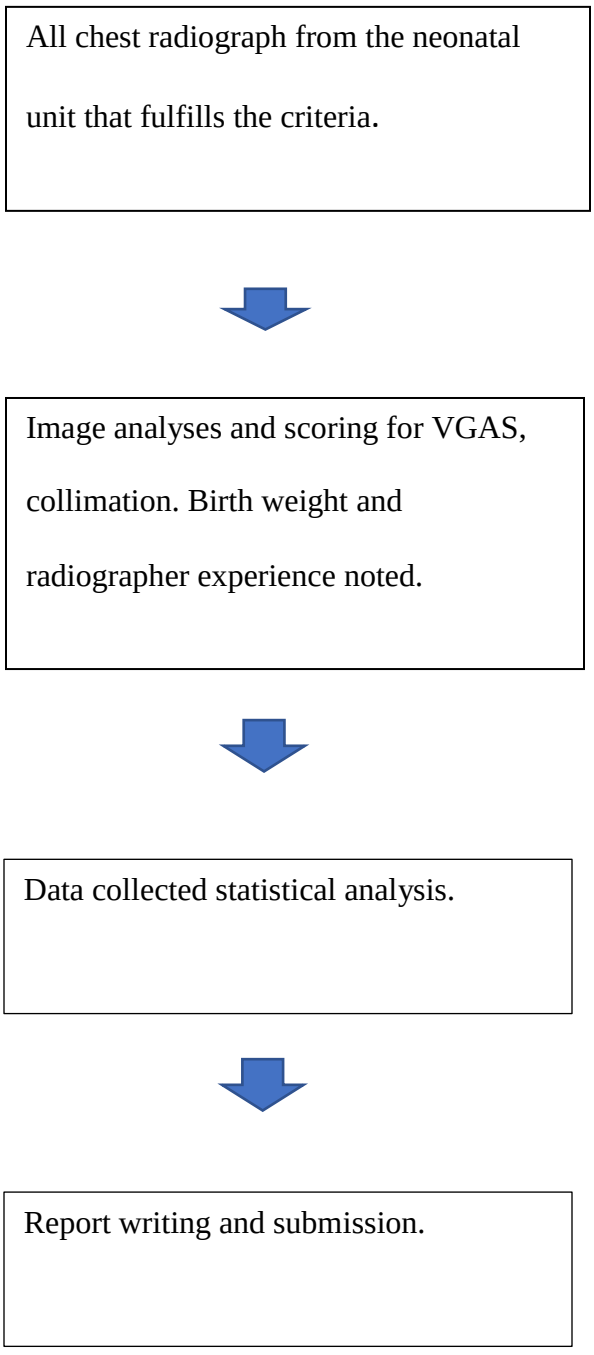

Figure 3: Study flow chart.

CHAPTER 4: MANUSCRIPT

MANUSCRIPT

TITLE PAGE:

Analysis of Image Quality of Pediatric Chest Radiography in The Neonatal intensive care unit (NICU) of Hospital Universiti Sains Malaysia (HUSM).

Authors:

Mohd Firdaus Bin Mohd Awal

Department of Radiology, School of Medical Sciences, Universiti Sains Malaysia

firdaus85@student.usm.my

Dr Ahmad Hadif Zaidin bin Samsudin

Department of Radiology, School of Medical Sciences, Universiti Sains Malaysia

hadif@usm.my

Abstract

Background: Chest radiography is the commonest radiography examination performed in the radiology department. It is vital to ensure the excellent quality of the chest radiograph performed to aid in diagnosing the clinical condition and to reduce the incidence of the repeated chest radiograph. One of the methods to analyse the quality of the chest radiograph is using a visual grading analysis score (VGAS) scoring. Other factors that affect the quality of the radiograph are image collimation by using collimation score and body weight.

This study aims to analyse the quality of the chest radiographic performed in our centre's neonatal intensive care unit (NICU) using a visual grading analysis score VGAS scoring. We also will study the correlation between VGAS score, collimation score, body weight and gender.

Methods: This cross-sectional study was done at NICU Hospital University Sains Malaysia, Kubang Kerian, Kelantan. A portable chest radiograph performed in the neonatal intensive care unit NICU during the study duration was reviewed and scored according to the VGAS scoring criteria and collimation score. The correlation between VGAS score, collimation score, body weight and age were tested using the Pearson correlation test. Correlation between VGAS score between males and females were tested using One-way ANOVA.

Results: The mean VGAS score and collimation score were 21.66 ± 1.54 and 2.57 ± 1.96 respectively. There is significant weak negative correlation between the collimation score and VGAS score ($r = -0.182$, $p = 0.010$). There is also a significant weak negative correlation between age and VGAS score ($r = -0.303$, $p < 0.001$). However, there was no significant correlation found between weight and VGAS score ($r = 0.035$, $p = 0.630$) and no significant difference in VGAS score between males and females ($F(1,195) = 0.669$, $p = 0.414$).

Conclusion: VGAS scoring for our center shows the excellent quality of chest radiographs. There are statistically significant correlation between VGA score with the collimation score and patient's age.

Keywords: VGAS scoring, chest radiograph quality analysis, collimation score, body weight.