

Influence of Patient's Positioning on the Quality of Bedside Echocardiography Images

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Abstract

Background: Echocardiography is particularly important for assessing hemodynamically unstable patients. Despite being carried out at the bedside to eliminate the risk resulting from patient's transportation, the imaging may be impaired. Proper patient's positioning could contribute to enhancing both the image quality and analysis of the exam.

Objective: To evaluate whether patient's positioning by nurses could influence the quality of the echocardiographic images obtained at the bedside.

Method: Patients whose examinations were requested to be carried out at the bedside were studied in a consecutive manner. During transthoracic echocardiography, videos of the parasternal longitudinal view (PLV) and 4-chamber apical view (Apical-4C) were obtained, as well as the still image of the aortic flow (FAo), in the left lateral decubitus (LLD) and supine decubitus (SD). The scanned images were blindly analyzed by two observers comparing the type of decubitus used. The image quality was rated as 1: good/excellent quality; 2: inadequate/poor, and then submitted to Kappa agreement test and Pearson correlation.

Resultados: 68 patients were studied, aged 69 ± 24 years, 37 males and body surface 1.85 ± 0.09 m². When the distinct views were compared, LLD images showed better quality ($p < 0.001$) when compared to SD for both the Apical-4C videos (Kappa 0.19) and PLV (Kappa 0.25) and FAo (Kappa 0.13); interobserver agreement of the quality of the images was 95%.

Conclusão: Patient's proper positioning in bed in left lateral decubitus contributes significantly to the acquisition of better quality images. 2016;29(4):132-135

Keywords: Echocardiography; Patient Positioning, Diagnostic Imaging, Critical Care; Point of Care Testing; Nursing Care.

Introduction

Transthoracic echocardiography is a method widely used in intensive care due to the cost, portability and potential to investigate the heart under the morphologic and hemodynamic point of view noninvasively.¹ Its easiness of operation at the bedside eliminates the risk involving the transport of these patients, many of whom are hemodynamically unstable or under respiratory assistance.^{2,3} However, some characteristics of these patients, as impossibility of cooperation, mechanical ventilation, thoracic or abdominal dressings, drains and catheters and compulsory supine position, add technical difficulties to the examination.⁴

Based on these characteristics, this study aims to assess whether the change in patient positioning during the

examination could influence on the technical quality of the images and whether additional factors could limit good-quality imaging at the bedside.

Methods

Patients

The study included patients aged above 18 years, of both genders, who underwent transthoracic echocardiography at the intensive care unit and emergency department of the emergency care, upon medical request and patients' need. No patient was excluded due to inadequate window, but patients unable to shift and maintain decubitus were excluded from the analysis.

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Transthoracic echocardiography

Tests were performed using a Philips IE33 device (Andover, Massachusetts, USA) and GE VIVID 07 (GE, Vingmed Ultrasound, Horten, Norway), with parasternal long and short axis views, apical 2-, 3-, and 4-chamber views, and subcostal and suprasternal views, obtained as part of a routine examination. For study evaluation, patients were positioned in the supine decubitus (SD) and left lateral decubitus (LLD). Video images were recorded specifically for parasternal longitudinal view (PLV) and apical 4-chamber view (Apical-4C), and the still image of the aortic flow (FAo) in the apical 5-chamber view for both LLD and SD. The images obtained for these planes were numbered so that they could be blindly evaluated by two observers without knowledge of the decubitus position in which the patient was at the moment of image acquisition. The image quality was rated as good/excellent or inadequate. Ten examinations were randomly selected to be reviewed by the same observer and, then, by an observer specifically for inter- and intraobserver evaluation.

Statistical analysis

Values expressed as mean $\pm$ SD or percentage. Kappa coefficient test was performed to measure the inter- and intraobserver agreement and to assess image quality in relation to recumbency, with both being submitted thereafter to McNemar test on each view. Body surface influence on the image quality (adequate/inadequate) on the different planes was analyzed by Student t test. The level of statistical significance was $p < 0.05$.

The study was approved by the Animal Ethics Committee for Research of Universidade Federal do Rio de Janeiro, under no. 166.550.

Results

The study population consisted of 140 patients who were submitted, upon referral, to echocardiography at the bedside, 73 (52%) of which were excluded due to total impossibility to shift the recumbent position for comparison of images. Thus, out of the 67 patients included in the study, 37 (55%) were males, aged 69 ± 24 years, with body surface area of 1.85 ± 0.09 m². Out of these patients, 4 were on invasive ventilation;

18 on noninvasive ventilation; 1 was on use of vasoactive drugs; 1 underwent angioplasty; 4 had thoracic drains and/or dressings. Body surface had no influence on the image quality for the different planes ($p = \text{NS}$). Also, no correlation was found between clinical data (drains, dressings, invasive and non-invasive ventilation) and image quality.

Image Assessment

A greater percentage of images considered good/excellent was observed when patients were positioned in LLD, with about 90% of patients generating images rated as good/excellent for the three planes studied in this decubitus position (PLV, $p < 0.001$, Apical-4C, $p < 0.001$ and $p = 0.008$ for FAo) compared with the supine decubitus, wherein only about two thirds of patients had good quality video images (Table 1). At the same time, PLV was observed to be the view most affected by SD positioning, with the greatest percentage of images considered inadequate (about 36% of the images deemed inadequate for this plane were in the SD positioning, compared with 10% of the images in the LLD positioning, $p < 0.001$). For the still image (aortic flow), approximately 27% of the images were considered inadequate when obtained in the SD positioning, compared to only 9% of the images obtained in the LLD positioning ($p < 0.001$, Table 1). The agreement for the three planes obtained at different recumbencies was therefore lower ($K < 0.95$).

The interobserver variation for analysis of the image quality in relation to recumbency position is shown in Chart 1, with a good agreement between the results for the study planes. The intraobserver agreement, similarly, was also adequate.

Discussion

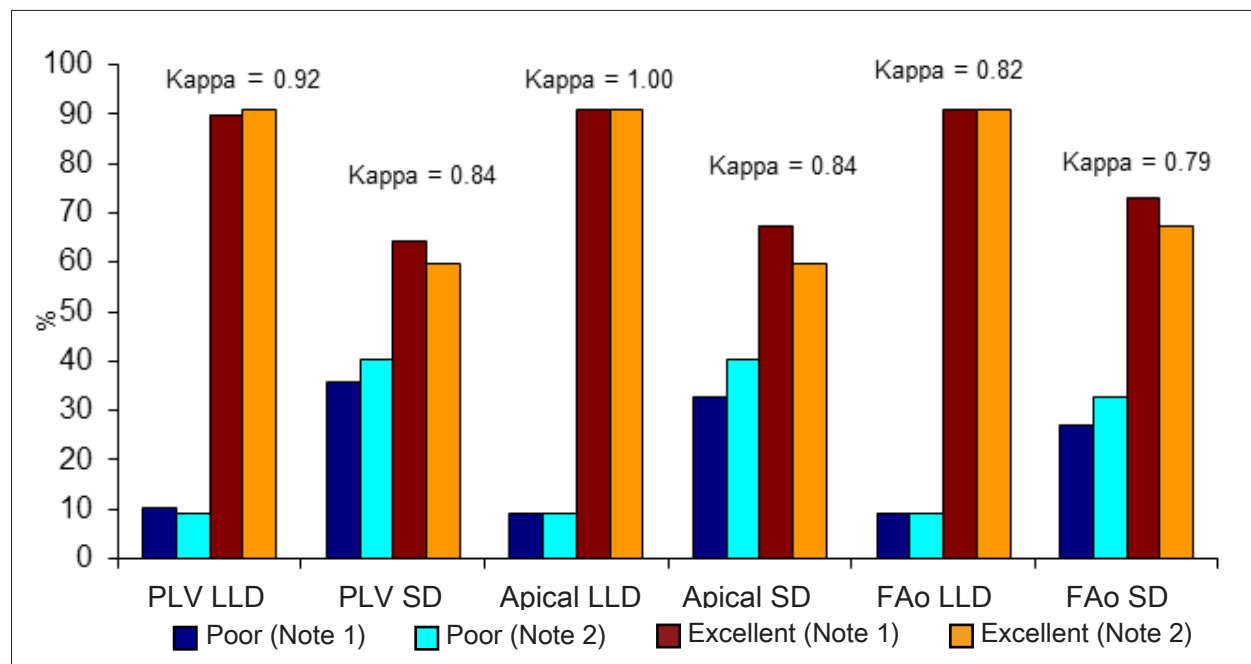
The importance in clinical practice of transthoracic echocardiography is mainly due to the real-time visualization of images of the heart in various sections, with enhanced detail. Examination at the bedside contributes to the quick and accurate identification of ventricular function, valvular alterations and hemodynamic assessment of critically ill patients, influencing decision-making, patient monitoring and responsiveness to fluid^{5,6} in these patients, who are oftentimes hemodynamically unstable. Examination at the bedside

Table 1 - Plane correlation with respect to positioning, confidence interval (CI) 95%, total study population (n = 67)

Plane	Position	IMAGE RATING		Kappa	p (McNemar)
		Good	Poor		
Parasternal longitudinal view	LLD	60 (89.6)	7 (10.4)	0.19	< 0.001
	SD	43 (64.2%)	24 (35.8%)		
Apical	LLD	61 (91%)	6 (9%)	0.25	< 0.001
	SD	45 (67.2%)	22 (32.8%)		
Aortic flow	LLD	61 (91%)	6 (9%)	0.13	0.008
	SD	49 (73.1%)	18 (26.9%)		

LLD: Patient positioned in the left lateral decubitus; SD: Patient positioned in the supine decubitus. * $p < 0.05$ (difference between quality echocardiographic images in the left lateral decubitus compared to the supine decubitus).

Chart 1 – Graphic representation of both observers' analysis of image quality in relation to recumbency



PLV LLD: Parasternal longitudinal section in the left lateral decubitus; PLV SD: Parasternal longitudinal section in the supine decubitus; APICAL LLD: Apical section in the left lateral decubitus; APICAL SD: Apical section in the supine decubitus; FAo LLD: Aortic flow section in the left lateral decubitus; FAo SD: Aortic flow section in the supine decubitus.

eliminates the risk involving patient's transportation and makes treatment safer.^{2,3} However, some peculiarities inherent in the care of critically ill patients, such as mechanical ventilation, chest dressing, as well as required supine position, can result in image artifacts due to deflection of the ultrasonic flow along its path, making it difficult, in 25% of cases, to interpret the image, due to its poor quality.⁴ Although several studies discuss on the application of echocardiography in clinical practice, the literature is scarce with regard to the evaluation of image quality in various recumbent positions. In our study, we blindly analyzed the influence of recumbency on the quality of the image obtained using transthoracic echocardiography performed at the bedside, and observed that the adequate positioning of the patient in the bed significantly influences the image quality of these patients. In this situation, we observed that patient positioning in left lateral decubitus contributes to the acquisition of a more appropriate image, in relation to the supine position, regardless of the analyzed plane (apical, parasternal longitudinal and aortic flow). In the left lateral decubitus, almost 90% of the images were considered of good quality, compared to only about two thirds of them when positioning was in the supine decubitus. Parasternal plane images were the most affected when performed from the supine position, which is a crucial finding considering that most measures of cardiac diameters are obtained from this plane.⁷

At the same time, as demonstrated, the percentage of inadequate quality images for aortic flow was significantly reduced when the patient was placed in left lateral decubitus.

This information is extremely important, given the need to adjust the alignment between Doppler axis and blood flow in order to optimize the analysis of flows through this valve. Image quality dramatically influences the degree of severity of valvular diseases, such as aortic stenosis.⁸ Thus, it seems to be more important spending a little more time in properly positioning the patient, as the final result would compensate by providing the best quality images. The improvement in the echocardiographic image quality, when it is obtained in the left lateral decubitus compared with the supine position, is probably associated with the mobilization of the heart, which moves from its rear position towards the sternum when the patient is positioned in the LLD; Moreover, for the apical view, the interference generated by interposition of lung tissue between the chest wall and heart is reduced, resulting in better quality images.⁹ Finally, some variables such as patient's body surface, invasive ventilation, chest drains and dressings, commonly associated with the deterioration of image quality^{10,11} in this study showed no significant influence on the final assessment as compared to the positioning of the patient; however, it is important to note that the number of patients with these characteristics was limited.

Inter and intraobserver evaluation: Regarding image interpretation, we observed excellent correlation between the findings when comparing the same observer's agreement and that of different observers, taking the planes assessed in the different positions into consideration.

Conclusion

The proper patient positioning in bed is extremely important to obtain good quality images, with a decrease of lower quality images prevalence, thus contributing to improving the accuracy of the test.

Authors' contributions

Research conception and design: Afonso TR; Data acquisition: Daminello E, Guimarães LA, Mônaco CG, Vieira MLC, Cordovil A, Oliveira WA, Fischer CH, Morhy SS, Rodrigues ACT; Data analysis and interpretation: Afonso TR, Daminello E, Guimarães LA, Rodrigues ACT; Statistical analysis: Oliveira WA; Manuscript writing: Afonso TR; Critical

revision of the manuscript's major intellectual content: Rodrigues ACT.

Potential Conflicts of Interest

No relevant conflicts of interest.

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Academic Association

This study is not associated to any graduate programs.

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