Differences in Leveling and Zeroing Methods on Intra-Arterial Pressure Parameters in Cardiac Catheterization Patients at Cath Lab Room of RSUP Dr. Hasan Sadikin Bandung

[1]Deni Agustian Muhidin, [2]Linlin Lindayani*

[1]Bachelor Student of STIKep PPNI Jawa Barat, Bandung
[2]Department of Nursing of STIKep PPNI Jawa Barat, Bandung

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Corresponding author
Linlin Lindayani
Sekolah Tinggi Ilmu Keperawatan PPNI Jawa Barat, Bandung, Indonesia
Jl. Muhammad No 34 Bandung, Indonesia
Email : lnlnlindayani@gmail.com

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Abstract

Objective: To compare the intra-arterial pressure (IAP) parameters obtained using standard transducers versus zero-line transducers during cardiac catheterization.

Method: A quasi-experimental study involving 73 patients undergoing cardiac catheterization at RSUP Dr. Hasan Sadikin Bandung was conducted. Systolic, diastolic, and mean arterial pressure (MAP) values were measured using both methods. Statistical analyses included Independent Samples T-tests.

Results: No significant differences were observed in systolic, diastolic, or MAP values between the two methods ($p > 0.05$). Mean differences were minimal (<1 mmHg) and attributed to the uniformity of patients' chest cavity dimensions (mean diameter: 18.33 ± 2.47 cm).

Conclusion: Reminiscence therapy has a significant effect on the levels of stress, anxiety, and depression in the elderly Zero-line transducers provide accuracy comparable to standard methods while offering operational simplicity. These findings advocate for their application in sterile and time-sensitive clinical settings.

Keywords: Hemodynamics, , Intra-Arterial Pressure, Leveling, Transducer, Zeroing, Zero Line

INTRODUCTION

Cardiovascular diseases (CVDs) remain the leading cause of death globally, accounting for 31% of all deaths, with ischemic heart disease and stroke as major contributors (WHO, 2020). In Indonesia, the prevalence of cardiovascular diseases reaches 1.5%, with West Java reporting higher-than-average rates at 1.6% (Riskesdas, 2018). These conditions impose a significant burden on the healthcare system, necessitating advanced diagnostic and interventional strategies.

According to the The Indonesian Society of Interventional Cardiology (ISIC), cardiac catheterization and stent placement are appropriate cardiology interventions in Indonesia for managing cardiovascular diseases. Cardiac catheterization is a cornerstone in the diagnosis and treatment of cardiovascular conditions (Latifah, 2022). Over 500 procedures

are performed annually in the RSUP Dr. Hasan Sadikin Bandung Cath Lab (Cath Lab, 2022). Accurate hemodynamic monitoring is integral to this process, as it guides clinical decisions, ensures patient safety, and enables precise therapeutic intervention (Scheeren & Ramsay, 2019).

Blood pressure is one of the hemodynamic elements that can be assessed using invasive and non-invasive methods (Fralinger, 2021). Intra-arterial pressure (IAP) monitoring serves as a critical parameter for assessing hemodynamic status. IAP provides real-time insights into systolic, diastolic, and mean arterial pressure (MAP), which are essential for evaluating cardiac output, systemic vascular resistance, and organ perfusion (Nguyen & Bora, 2020). Leveling and Zeroing in IAP Monitori Leveling ensures the transducer is positioned at the phlebostatic axis, corresponding to the right atrium, eliminating the effects of hydrostatic pressure (Saugel et al., 2020). For every 2.5 cm deviation from this axis, measured pressure can shift by approximately 1.87 mmHg, potentially altering clinical decisions (Nguyen & Bora, 2020). Zeroing, meanwhile, eliminates atmospheric pressure interference, standardizing the transducer to display a baseline of 0 mmHg.

Traditional methods using transducers without zero line require careful height adjustments, which can be challenging in sterile environments (Jerman et al., 2023). Zero-line transducers simplify this by integrating a fluid-filled line directly connected to the phlebostatic axis, bypassing positional adjustments.

Despite the potential benefits of zero-line transducers, limited research has been conducted to validate their accuracy, particularly in Indonesia. This study aims to bridge that gap by comparing these methods in a clinical setting.

METHODS

Study Design

A quasi-experimental design was employed, comparing two groups of IAP measurements; Standard Method: Measurements using transducers without zero line. Zero-Line Method**:** Measurements using transducers with zero line.

Population and Sample

The population were patient at elective cardiac catheterization at RSUP Dr. Hasan Sadikin Bandung in December 2023 were enrolled. Sample size was calculate using G-Power software version 3.1.9.7 using t-test, means: difference between two independent means (two groups), assuming two tails, $\alpha = 0.05$, effects size: 0.45, power level: 0.95, plus attrition rate, and the number of samples was 73. The inclusion criteria was patient with hemodynamic stability, arterial catheter placement. Non-cooperative patients or patients who in emergency conditions were excluded.

Instruments

Measurements were using the Philips Xper Information Management System 5.1 and Siemens Syngo Sensis VC 12M. These systems are integrated with catheterization laboratory equipment, providing accurate, real-time data on arterial pressure and hemodynamic parameters. Chest cavity dimensions were measured using a 300-mm caliper to standardize hydrostatic influences (Jerman et al., 2023).

Procedure Intervention

IAP parameters, including systolic, diastolic, and MAP values, were measured twice for each patient, using both methods. Measurements were conducted sequentially, ensuring consistent patient positioning and environmental factors.

Data Analysis

Data were analyzed using SPSS version 26. Independent Samples T-tests evaluated differences in IAP values between methods (Crowther et al., 2022).

RESULTS

Participant Characteristics

The participants had a mean age of 54.6 ± 8.9 years, with a gender distribution of 58% male and 42% female, indicating a balanced representation of both genders.

Table 1. Demographic characteristics of respondents (n=73)

Variable	Mean ± SD (Range)
Age (Year)	51.25± SD19.53 (1-76)
Height (cm)	155.73± SD19.74 (72-175)
Weight (cm)	60.29± SD18.88 (7-98)
IMT (kg/m2)	23.83± SD 4.91 (12.1-32.4)
Diameter AP	18.33± SD2.47 (10.5-22)

Table 2. Differences in intra arterial pressure parameter values measured using the exposure method and the standard method

	Eksposur		Satandar		*Sig.	Mean diff.	**P-value	95% CI	
	Mean ±(SD)	Min-Max	Mean ±(SD)	Min-Max				Lower	Upper
Sistolik	124.40±27.68	71-216	124.56±28.28	69-219	0.907	-0.164	0.972	-9.319	8.990
Diastolik	70.33±14.83	30-120	70.78±14.30	37-111	0.967	-0.452	0.852	-5.219	4.315
MAP	92.56±17.34	58-151	92.96±17.98	57-155	0.894	-0.397	0.892	-6.174	5.379

The mean anterior-posterior (AP) chest cavity diameter was 18.33 ± 2.47 cm, with minimal variability across the cohort.

Comparison of IAP Parameters

No significant differences were observed between the two methods across all IAP parameters:

- Systolic Pressure: Mean difference = 0.164 mmHg, p = 0.972.
- Diastolic Pressure: Mean difference = 0.452 mmHg, p = 0.852.
- MAP: Mean difference = 0.397 mmHg, p = 0.892.

These findings demonstrate equivalent accuracy between methods, with minimal bias in IAP values (<1 mmHg difference) (Table 2.).

DISCUSSION

This study confirms that zero-line transducers offer comparable accuracy to traditional methods in IAP measurement. These findings align with previous research by Saugel et al. (2020) and Nguyen & Bora (2023), who highlighted the critical role of precise transducer alignment in eliminating hydrostatic and atmospheric pressure effects (Nguyen & Bora, 2020)(Saugel et al., 2020).

Practical Advantages of Zero-Line Transducers

Zero-line transducers provide significant advantages in procedural simplicity and efficiency, particularly in sterile settings where height adjustments can be cumbersome. This is consistent with findings by Jerman et al. (2023), who emphasized the operational benefits of zero-line systems in intensive care environments (Jerman et al., 2023). Additionally, McNett et al. (2018) demonstrated that improper transducer positioning could result in clinically significant deviations in IAP readings, underscoring the value of systems that minimize operator dependency (McNett et al., 2018). Zero-line transducers reduce such variability, ensuring consistent measurements irrespective of operator skill or environmental constraints.

Implications for Clinical Practice

The operational simplicity of zero-line transducers makes them particularly suitable for high-stakes environments, such as cardiac catheterization and intensive care units. By eliminating the need for positional adjustments, these systems reduce the potential for error and

streamline workflow, contributing to improved patient outcomes.

Study Limitations

While the study demonstrates the accuracy and utility of zero-line transducers, it is limited to a homogeneous patient population undergoing elective procedures. Further
research is needed to explore their applicability in diverse clinical scenarios, including critically ill patients and emergency settings.

CONCLUSION

Zero-line transducers provide an equally accurate and more practical alternative to traditional methods for IAP monitoring. Their integration into clinical practice is recommended, particularly in environments requiring strict sterility and time efficiency.

Recommendations

Future studies should evaluate zero-line transducers in varied patient populations and explore their cost-effectiveness in large-scale applications.

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