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Comparison of Palpation Methods When Performing Physician Ordered Arterial Puncture for Sampling Arterial Blood

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Abstract

Introduction: The palpation technique utilized when performing an arterial blood gas puncture by health care professionals is often not described or is illustrated as a technique in which two fingers perpendicular to the artery are utilized. A single-finger linearly aligned (SAL) technique might be simpler to palpate and mentally visualize the artery than a multi finger approach. This study was conducted to ascertain if technique can affect the number of puncture attempts required to obtain an arterial blood sample.

Methods: Volunteer clinical participants, from multiple heath care professions including attending medical staff, respiratory therapists and nursing staff were randomly assigned to one of two groups. and taught either the MAP technique (n=70) (40.4%) or SAL technique (n=106) (59.6%) After instruction and practice each participant's ABG sampling performance was evaluated utilizing an arterial puncture training simulator and each participant completed a perception survey.

Results: Participants largely perceived that the training prepared them to obtain an arterial sample: Logistics regression and Binary logistic regression were conducted: the results of the logistics regression model were significant, suggesting that the MAP technique had a significant effect on the odds of observing the category of first-time unsuccessful by approximately 71.8% relative to the SAL technique.

Conclusions: The results of this study within the clinical setting again suggested that moving from the MAP to the SAL technique will decrease the number of attempts required to obtain a sample and increase the odds of obtaining a sample on the first attempt.

Keywords: Arterial blood gas; Palpation; Multi-finger aligned perpendicular; Single aligned linearly; Linear regression analysis

Abbreviations: ABG: Arterial Blood Gas; MAP: Multi-Finger Aligned Perpendicular; SAL: Single Aligned Linearly

Introduction

The technique to palpate the artery prior to performing an arterial puncture is often not described in textbooks and procedures. When it is described or illustrated it is often a technique in which palpation is merely described, or two fingers are utilized to palpate the artery, and the fingers are perpendicular to the artery [1]. It makes some intuitive sense that a single-finger technique might be simpler to palpate and mentally visualize the artery and that if the finger is aligned linearly with the artery, that the center of the fingernail might provide a precise target This single-finger, aligned linearly (SAL) palpation technique was compared to a palpation technique using multiple-fingers, aligned perpendicular to the artery (MAP), which is often taught.

Previously, in clinical practice, one of the investigators had shown this single-finger, aligned linearly (SAL) technique to people who were having difficulty consistently obtaining samples using more traditional palpation methods. Anecdotal

observations showed that the technique improved consistency of obtaining a sample on the first attempt for some people. The authors conducted a study with respiratory care students who volunteered to participate in a controlled lab setting to assess if use of a single-finger aligned linearly (SAL) with the artery would improve success in obtaining a sample from a radial artery simulator. The results of the lab study with student participants indicated that use of the SAL technique would improve the odds of obtaining a sample on the first puncture attempt and decrease the number of attempts required to obtain a sample [2].

Given the results of the earlier study, the authors conducted a modified version of the lab study to determine if similar results would be observed in the clinical setting with ABG sampling by trained healthcare professionals. This study was conducted utilizing healthcare professionals to answer the research question: Can the technique used to palpate the artery effect the number of puncture attempts required to obtain an arterial blood sample? Thusly, decreasing discomfort to the patient, ascertaining results in a timelier fashion, and decreasing overall costs.

Methods

This investigation was approved by the Institutional Review Board of the Youngstown State University and the Institutional Review Board at Bon Secor Mercy health where the secondary study was conducted. Health care professionals consisting of attending medical staff, respiratory therapists, nursing and those being trained to perform arterial blood gas sampling within this healthcare facility were invited to voluntarily participate in an arterial blood gas (ABG) technique study. Participants read, signed, and dated a consent form prior to the start of the ABG palpation technique study. The consent form explained the study, confidentiality of individual participant's results and described the expectations of participants. Participants were randomly assigned to one of two groups, as evenly as possible. Participants in one group were taught the traditional, multi-finger aligned perpendicularly (MAP) palpation technique. The participants within the other group were instructed on the single-finger aligned linearly (SAL) palpation technique.

The participants were separated. Participants watched an instructional video - demonstrating the technique assigned and then observed a live demonstration of the same palpation technique as part of the ABG sampling procedure, conducted using a Kagaku Kyoto arterial puncture wrist training simulator, and the Portex pro vent arterial blood gas sampling kit, for continuity between participants. The participants in each group were advised and agreed not to watch or practice any other technique during the study. After participants in both groups had a practice period that averaged twelve days, each participant was evaluated by an instructor on his/her performance of the assigned technique (MAP or SAL) technique utilizing the ABG training simulator, ABG syringe and supplies. The evaluation of the participants' performance in the MAP technique group was completed over a single day by the group instructor/supervisor. The evaluation of performance of participants in the SAL technique group was also completed over a single day period by the instructor/supervisor of that group. When the study was concluded a subject perception survey was completed by each participant. Participants were offered the opportunity to learn and be trained in the other palpation technique after the performance and perception results were obtained.

Results

Healthcare professionals from various healthcare disciplines volunteered to participate in this study. The participants were randomized into two groups. One group was taught the single finger aligned linearly (SAL) palpation technique (n=106) (59.1%). The other group (n=70) (40.1%) served as a control group and received no additional training. This group was offered the opportunity to be trained in the SAL technique after the collection of clinical results was completed. The participants in the control group were predominantly female (80%), college educated at the graduate or undergraduate level. and ranged in age from 20 to 46 years of age with a mean age of 33 (Table 1). Participants in the SAL group revealed similar characteristics, predominately female (88%) educated at the graduate or undergraduate level and ranged in age from 29 to 60 years of age with a mean of 44.9 years of age. All participants were licensed and practiced within their professional discipline. Additional descriptive statistics are provided in (Table 2).

Table 1: Summary Participant Statistics Table for Interval and Ratio Variables by Technique.

Variable	M	SD	n	SEM	Min	Max	Skewness	Kurtosis
Age								
Control	33.26	3.79	70	1.04	20	46	3.11	12.14
SAL	44.92	2.23	106	0.38	29	60	2.44	3.26

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Table 2: Frequency Table for Nominal and Ordinal Variables.

Variable	Technique		
	SAL	MAP	Missing
ABG_Self_Efficacy			
Agree	14 (54%)	13 (54%)	0 (0%)
Strongly Agree	9 (35%)	7 (29%)	0 (0%)
Disagree	1 (4%)	1 (4%)	0 (0%)
Neither agree, nor disagree	2 (8%)	3 (12%)	0 (0%)
Missing	0 (0%)	0 (0%)	0 (0%)
Total	26 (100%)	24 (100%)	0 (100%)
Previous_ABG_Experience			
No	23 (88%)	22 (92%)	0 (0%)
Yes	2 (8%)	1 (4%)	0 (0%)
Missing	1 (4%)	1 (4%)	0 (0%)
Total	26 (100%)	24 (100%)	0 (100%)
Ed_Level_2			
Some College	22 (85%)	21 (88%)	0 (0%)
Associate's Degree	2 (8%)	2 (8%)	0 (0%)
Bachelor's Degree	2 (8%)	1 (4%)	0 (0%)
Missing	0 (0%)	0 (0%)	0 (0%)
Total	26 (100%)	24 (100%)	0 (100%)
Instruction_Clear_Easy			
Strongly Agree	23 (88%)	20 (83%)	0 (0%)
Agree	3 (12%)	4 (17%)	0 (0%)
Missing	0 (0%)	0 (0%)	0 (0%)
Total	26 (100%)	24 (100%)	0 (100%)
Perception_of_Training			
Strongly Agree	23 (88%)	17 (71%)	0 (0%)
Agree	2 (8%)	6 (25%)	0 (0%)
Neither agree, nor disagree	1 (4%)	1 (4%)	0 (0%)
Missing	0 (0%)	0 (0%)	0 (0%)
Total	26 (100%)	24 (100%)	0 (100%)
Ease_Visualization			
Strongly Agree	14 (54%)	16 (67%)	0 (0%)
Agree	11 (42%)	6 (25%)	0 (0%)
Neither agree, nor disagree	0 (0%)	2 (8%)	0 (0%)
Disagree	1 (4%)	0 (0%)	0 (0%)
Missing	0 (0%)	0 (0%)	0 (0%)
Total	26 (100%)	24 (100%)	0 (100%)

Note: Due to rounding error, percentages may not sum to 100%.

Analysis

Data were analyzed using Intellectus Statistics software [3]. Figures, Tables and some narrative reporting in this report were generated using Intellectus Statistics. Descriptive and Inferential Statistics are reported.

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Frequencies, Percentages and Summary Statistics

Participants in the Control group (n=70) either strongly agreed (n=41, 58%) or agreed (n=28, 40%) that they had self-efficacy for successful ABG sampling (were confident that they could obtain a sample from most patients on their first puncture attempt). Comparably, those trained to use the SAL technique (N=106) strongly agreed (n=44, 42.4%) or agreed (n=61, 57.2%) that they had self-efficacy for successful ABG sampling. The participants largely perceived that the training, including hands-on practice, prepared them to obtain an arterial sample from a patient (Control: strongly agreed (n=26, 37%) agreed (n=38, 54%) or neural (n=6, 8%); SAL: strongly agreed (n=44, 42.4 %) agreed (n=61, 57.8%) or neural (n=1, < 1%). All participants in both Control and SAL groups agreed or strongly agreed that the instruction provided was clear and easy to understand. Frequencies and percentages for additional variables are available in (Table 2).

Summary statistics were calculated for attempts split by technique. Attempts required by those trained in the MAP technique were greater than those trained in the SAL technique (Figures 1 and 2). MAP, the observations of Attempts had an average of 1.62 (SD = 1.13, SEM = 0.23, Min = 1.00, Max = 6.00, Skewness = 2.60, Kurtosis = 7.28). SAL, the observations of Attempts had an average of 1.12 (SD = 0.33, SEM = 0.06, Min = 1.00, Max = 2.00, Skewness = 2.41, Kurtosis = 3.80). When the skewness is greater than 2 in absolute value, the variable is considered to be asymmetrical about its mean. When the kurtosis is greater than or equal to 3, then the variable's distribution is markedly different than a normal distribution in its tendency to produce outliers [4]. The values for attempts indicate that the data analyzed are not normally distributed. This violates one of the assumptions of linear regression analysis. [5] indicate that analysis of data that does not meet the normality assumption is not usually a problem for regression tests since they are robust to non-normal distributions. The summary statistics can be found in (Table 3).

Table 3: Summary Statistics Table for Interval and Ratio Variables by Technique.

Variable	M	SD	n	SEM	Min	Max	Skewness	Kurtosis
Attempts	++++++							
SAL	1.12	1.09	106	0.16	1	2	2.41	2.8
Control	2.52	1.33	70	0.26	1	4	3.44	4.29

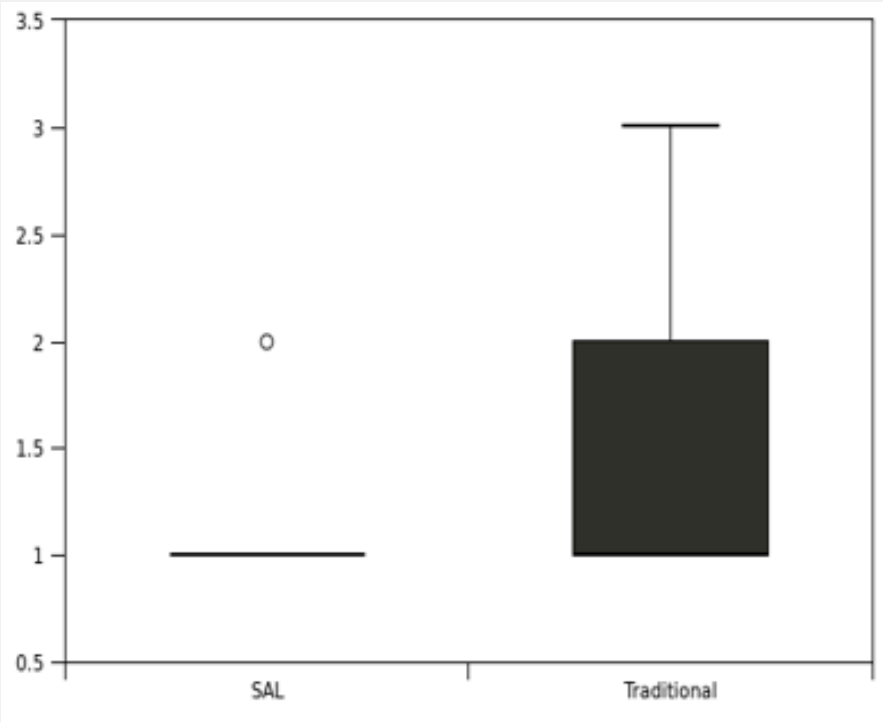

Figure 1: Boxplot of average Attempts by Technique.

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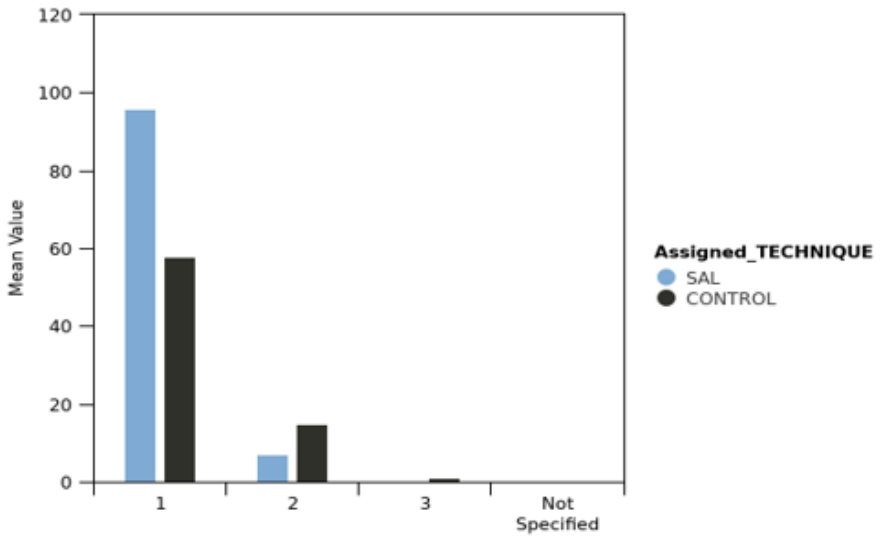

	Assigned Technique		
Success	**SAL**	**CONTROL**	**Missing**
Successful	97 (54.80%)	65 (36.72%)	0 (0.00%)
Unsuccessful	5 (2.82%)	9 (5.08%)	0 (0.00%)
Note: Due to rounding errors, percentages may not equal 100%.			

Crosstabulation for first-time Success by Assigned Technique.

Figure 2: Bar plot of first-time Success by Assigned Technique.

Linear Regression Analysis

A linear regression analysis was performed to ascertain whether the technique utilized significantly predicted the number of puncture attempts needed by participants to obtain a sample. The maximum number of attempts permitted to obtain a sample was limited by hospital policy.

Results

The model was evaluated based on an alpha of 0.05. The overall model was significant, $\chi^2(1) = 3.89$, p=.035, suggesting that palpation technique had significance on the odds of observing the Unsuccessful category for the Control or MAP category. McFadden's R-squared was calculated to examine the model fit, where values greater than .2 are indicative of models with excellent fit The McFadden R-squared value calculated for this model was 0.13. The regression coefficient for Technique Traditional or MAP was significant, B = 2.01, OR = 2.51, p = .035, indicating that Technique MAP, had a significant effect on the odds of observing the Unsuccessful on the first attempt category (2.5 to 1). (Table 4) summarizes the results of the regression model.

Binary Logistic Regression

Introduction A binary logistic regression was conducted to examine whether No_of_Attempts had a significant effect on the odds of observing the SAL category of Assigned Technique The reference category for Assigned Technique was Control or MAP.

Results

The model was evaluated based on an alpha of .05. The overall model was significant, $\chi^2(2) = 9.06$, p = .011, suggesting that No_of_Attempts_1 had a significant effect on the odds of observing the SAL category of Assigned Technique. McFadden's R-squared was calculated to examine the model fit, where values greater than .2 are indicative of models with excellent fit. The McFadden R-squared value calculated for this model was 0.04. The effect of the of No_of_Attempts_3 category was significant, B = -1.27, OR = 1.8, p = .009, indicating that observing the category of No_of_

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Attempts_3 decreases the odds of observing the SAL category of Assigned Technique by approximately 71.8% relative to the category of No_of_Attempts _1. (Table 5) summarizes the results of the Binary Logistics Regression model.

Table 4: Logistic Regression Results with Technique Predicting Attempt Success.

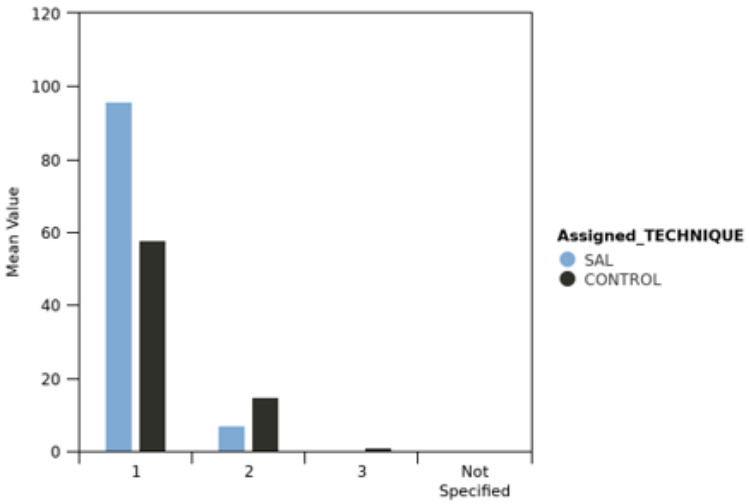
Variable	B	SE	95% CI	χ^2	p	OR
(Intercept)	-2.71	1.03	[-4.73, -0.68]	6.88	0.009	
Technique MAP	2.01	1.17	[-0.28, 4.31]	2.97	0.035	2.51

Note: $\chi^2(1) = 3.89$, $p = .035$, McFadden $R^2 = 0.13$.

Table 5: Logistic Regression Results with No_of_Attempts Predicting Assigned Technique.

Variable	B	SE	χ^2	p	OR	95.00% CI
(Intercept)	0.5	0.17	9.18	0.002	-	-
No_of_Attempts_1	-1.27	0.49	6.76	0.009	1.8	[0.11, 0.73]
No_of_Attempts_3	-15.07	882.74	0	0.986	3E-07	[0.00, Inf]

Note: $\chi^2(2) = 9.06$, $p = .011$, McFadden $R^2 = 0.04$.



	Assigned Technique		
No of Attempts	SAL	CONTROL	Missing
1	96 (91.24%)	58 (32.77%)	0 (0.00%)
2	7 (3.95%)	15 (8.47%)	0 (0.00%)
3	0 (0.00%)	1 (0.56%)	0 (0.00%)
Note: Due to rounding errors, percentages may not equal 100%.			

Cross tabulation for No_of_Attempts by Assigned_Technique.

Figure 3: Bar plot of number of attempts by assigned technique.

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Summary statistics were calculated for attempts separated by technique. Attempts required by participants trained in the Control group who continued to utilize their current palpation technique revealed to be greater than participants trained in the SAL technique, the Control observations of attempts had an average of 2.52 (SD = 1.33, SEM = 0.26, Min = 1.00, Max = 4.00, Skewness = 3.44, Kurtosis = 4.29). SAL, technique observations of attempts had an average of 1.22 (SD = 1.09, SEM = 0.16, Min = 1.00, Max = 2.00, Skewness = 2.41, Kurtosis = 2.80). The summary statistics can be found in (Table 3)., number of attempts, by technique, successful first attempts by technique and number of techniques by technique are represented in (Figure 1-3) respectively.

Conclusion

The results of this study suggest that the palpation technique for manually acquiring an arterial blood gas sample, utilized at the patient bedside, can affect the number of puncture attempts required to obtain an arterial blood sample for diagnostic analysis. Results of this study suggest that the palpation technique employed, explained about 17.8% of the variance in the number of attempts required to obtain an arterial blood gas sample within the clinical setting. The results were significant. This investigative model predicts that moving from the MAP or Control technique, often taught to healthcare individuals during their education and training, to the SAL technique, will decrease the number of attempts required to obtain a sample. Although that decrease is small (1.07 attempts on average) patients and the healthcare system would benefit from a palpation technique that minimizes the number of punctures necessary to obtain a sample. The results also indicate that moving from the MAP technique to the SAL technique will increase the odds of obtaining a sample on the first puncture attempt by 71.8%. Similarly, patients would likely benefit from improved odds that the person sampling their arterial blood would be successful on their first attempt.

Early success in performing procedures is important to establish confidence for obtaining ABG samples and if changing how healthcare providers are instructed to palpate the artery can lead to increased odds of success on the first attempt and decrease the number of attempts required to obtain a sample, thusly decreasing discomfort to patients, decreasing the time in achieving result information and decreasing the overall cost of providing care. The SAL palpation technique (as compared to the MAP technique) has shown promise in minimizing the number of attempts needed to obtain arterial blood samples from patients in the clinical setting.

References

1. Seccombe LM, Keatley DR, Robles RA, Reesor SR, Brazzale DJ (2024) Australian and New Zealand Society of Respiratory Science position statement for arterial blood gas sampling. Intern Med J 54(7): 1208-1213.
2. Sanders, SA, Colwell, KL Snyder, KA (2023) Arterial Blood Gas Sampling: The Relationship between Palpation Technique and Student Success using a Training Simulator. Int J Pul & Res Sci 6(4): 555695.
3. Intellectus Statistics [Online computer software]. (2024) Intellectus Statistics.
4. Davis MD, Walsh BK, Sittig SE, Restrepo RD (2013) AARC clinical practice guideline: blood gas analysis and hemoximetry: 2013. Respiratory care 58(10): 1694-1703.
5. (1992) AARC clinical practice guideline. Sampling for arterial blood gas analysis. America Association for Respiratory Care. Respiratory care 37(8): 913-917.

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