

1992

# Evaluation of Coagulation Studies Drawn from Heparinized Arterial Lines

Lois J. Van Donselaar  
*Grand Valley State University*

Follow this and additional works at: <http://scholarworks.gvsu.edu/theses>



Part of the [Nursing Commons](#)

---

## Recommended Citation

Van Donselaar, Lois J., "Evaluation of Coagulation Studies Drawn from Heparinized Arterial Lines" (1992). *Masters Theses*. 93.  
<http://scholarworks.gvsu.edu/theses/93>

This Thesis is brought to you for free and open access by the Graduate Research and Creative Practice at ScholarWorks@GVSU. It has been accepted for inclusion in Masters Theses by an authorized administrator of ScholarWorks@GVSU. For more information, please contact [scholarworks@gvsu.edu](mailto:scholarworks@gvsu.edu).

EVALUATION OF COAGULATION STUDIES  
DRAWN FROM HEPARINIZED ARTERIAL LINES

By

Lois J. Van Donselaar

A THESIS

Submitted to  
Grand Valley State University  
in partial fulfillment of the requirements  
for the degree of

MASTER OF SCIENCE IN NURSING

Kirkhof School of Nursing

1992

Thesis Committee Members:

Patricia Underwood, Ph.D.

Johnine Calahan, Ph.D.

Steven Merrill, MSN

## ABSTRACT

### EVALUATION OF COAGULATION STUDIES DRAWN FROM HEPARINIZED ARTERIAL LINES

By

Lois J. Van Donselaar

Drawing blood from indwelling heparinized arterial catheters is a common procedure in critical care units. The accuracy of coagulation studies drawn from heparinized arterial lines has been a source of controversy and divergent results of research studies. The discarding of blood to provide an uncontaminated specimen is a concern as a source of infection for health care workers. This study evaluates the accuracy of aPTT results drawn from the Lab-Site pressure tubing system which provides a closed system that eliminates blood discard. Blood was obtained from radial artery catheters connected to the Lab-Site system and compared to specimens obtained simultaneously, by venipuncture. The paired t-test indicated no significant difference between the arterial and venous samples. The Pearson product moment correlation of 0.619 indicated good correlation between arterial and venous values. The mean difference between the arterial and venous aPTT results was 1.49 seconds with S.D. of 3.925. The researcher concluded that accurate aPTT results can be obtained from heparinized arterial lines when specific procedures are followed.

## Acknowledgements

This thesis could not have been completed without the assistance of the following: Kalamazoo Nursing Research Collective for grant funds; Patricia Underwood, Ph.D. for assistance throughout the entire process; Cardiac Surgical Unit staff, Pre-Surgical Testing staff, Laboratory staff, and Cardiac Surgical Services staff of Borgess Medical Center for assisting with data collection; Abbott Critical Care, North Chicago, Illinois for supplying tubing for the study.

Lois J. Van Donselaar

## Table of Contents

List of Tables . . . . .	iv
List of Figures . . . . .	v
List of Appendices . . . . .	vi
CHAPTER	
1 INTRODUCTION . . . . .	1
2 REVIEW OF LITERATURE AND CONCEPTUAL FRAMEWORK .	3
Review of Literature . . . . .	3
Conceptual Framework . . . . .	10
3 METHODOLOGY . . . . .	13
Study Design . . . . .	13
Sample . . . . .	13
Procedures . . . . .	15
4. RESULTS/DATA ANALYSIS . . . . .	18
Characteristics of Subjects . . . . .	18
Data Analysis . . . . .	18
Other Findings of Interest . . . . .	22
5. DISCUSSION AND IMPLICATIONS . . . . .	24
Discussion . . . . .	24
Application to Practice . . . . .	25
Limitations of this Study . . . . .	26
Suggestions for Further Research . . . . .	27

List of Tables

Table 1.	Summary of Previous Research Studies Related to Dead Space Volume and Discard Volume . . . . .	4
Table 2.	Eligibility Criteria for Inclusion in the Study . . . . .	14
Table 3.	Procedure for Drawing Specimens from the Lab-Site Tubing . . . . .	18
Table 4.	Individual aPTT Values Obtained for Intra- Arterial Line and Venipuncture Samples . .	21
Table 5.	Comparison of Arterial and Venous aPTT Values by Paired t-test. . . . .	22

## List of Figures

Figure 1.	Conceptual Framework . . . . .	10
Figure 2.	Arterial - Venous aPTT Differences . . . . .	10
Figure 3.	Comparison of aPTT arterial and venous means and 95% confidence intervals (n = 24). . . . .	21

## List of Appendices

### APPENDICES

A.	aPTT Research Study Participant Data Sheet . . .	32
B.	Explanation of the Study and Consent Form . . .	33

## CHAPTER 1

### INTRODUCTION

Critically ill patients often require coagulation studies to assess their clotting systems or to guide anticoagulation therapy. The process of drawing blood specimens from indwelling heparinized arterial catheters is a common procedure in critical care units. The reasons for using indwelling lines to obtain blood specimens include the frequency with which laboratory studies are performed, limited venous sample sites and the stress and discomfort associated with frequent venipuncture. The heparinization of the flush solutions used to maintain patency of the arterial line poses a potential error factor in coagulation studies drawn from arterial lines due to the anticoagulation action of heparin. Researchers have examined the effect of various procedures for drawing coagulation studies on the accuracy of the tests and have obtained a variety of results. Differences in results were largely a function of the limitations--in design, control and sample size.

The increased concern about exposure to blood as a source of potential infection for the health care worker has stimulated the development of a new high pressure arterial line system that is designed to allow blood to be drawn

without discarding any of the patient's blood to clear the line of heparin. This system which eliminates the discarding of a patient's blood also eliminates the blood discarding procedures as a potential cause for iatrogenic anemia (Henry, Garner, & Fabri 1986).

The purpose of this study was to examine the reliability of activated partial thromboplastin time (aPTT) drawn from a specific arterial line system as compared to venipuncture results. This study examined the correlation between the arterial and venous aPTT results.

The research question was: What differences are there between aPTT results drawn from an indwelling arterial catheter using the Lab-Site pressure tubing and results obtained by venipuncture?

## CHAPTER 2

### REVIEW OF LITERATURE AND CONCEPTUAL FRAMEWORK

#### Review of Literature

The literature has pointed to the use of heparinized flush solutions, amount of discard and method of drawing the sample as procedural issues which potentially influence the test results. Discarding fluid drawn from the line prior to obtaining the specimen is intended to clear the heparinized solution from the line thereby providing a non-contaminated sample for the coagulation studies. The term "dead space" is used to describe the volume of fluid contained in the catheter system from the tip of the catheter to the point of draw in the line.

#### Dead Space and Discard Volume

Several studies have examined the relationship between dead space, discard volume and the correlation between arterial and venous aPTT values. A summary of these studies is displayed in Table 1. The recommended discard volume varied from two times the dead space (Palermo, 1980; Cannon, 1985) to ten times the dead space (Kajs, 1986; Kaplow, 1988).

Table 1

Summary of Previous Research Studies Related to Dead Space  
Volume and Discard Volume

Study	n	Dead space	Discard	Recommended Discard Volume
Palermo et al., 1980	12	1.79 ml	DS + 0 DS + 1 DS + 2 DS + 4	2 x DS
Pryor, 1983	50	unknown	6 ml	No specific reference to recommended volume
Kajs, 1986	A 12 B 12	0.6 ml	A 3 ml (5 x DS) B 6 ml (10 x DS)	Significant difference between arterial and venous results. Recommended > 10 x DS
Molyneaux et al., 1987	60	0.8 ml	1.6 (2 x DS) 3.2 (4 x DS) 4.8 (6 x DS)	Discard volume ≥ 6 x DS
Gregerson et al., 1987	30	0.6 ml	0.6 ml 5.1 ml 9.6 ml 14.1 ml 18.6 ml	Discard volume of 8.5 x DS
Kaplow, 1988	50	1.0 ml	10.0 ml (10 x DS)	Discard volume of 10 x DS
Rudesill & Moore, 1989	A 30 B 29	2 ml	A 4 x DS B 6 x DS	Discard volume of 6 x DS
Cannon et al., 1985	50	1.0 ml	2 x DS	Discard volume 2 x DS

DS = Dead space

Pryor (1983) compared 50 paired specimens from 49 patients with indwelling arterial lines discarding a 6 ml volume which is called "discard". The dead space of the system was not specified. The arterial and venous values were significantly correlated ( $r = 0.9928$ ,  $p < 0.001$ ) leading the researchers to conclude that specimens for PT and aPTT tests could be drawn from arterial lines. These results are difficult to evaluate since the system dead space is not known.

Conflicting results were reported by Kajs (1986) based on a study of 24 patients divided into two groups. The first group had aPTT samples drawn after a 3 ml discard volume and the second group after a 6 ml discard volume. The discard volumes represent five and ten times the system dead space respectively. The arterial aPTT results showed significant differences from the venous control results in both the 3 ml and 6 ml discard volume groups. The small sample size is a concern with this study.

Molyneaux, et al. (1987) used 60 paired specimens drawn from 24 patients to evaluate the effect of different amounts of discard volume on the correlation of arterial and venous control samples. The volumes of discard studied were two, four and six times the dead space. Significant differences were noted in the groups using discard volumes of two and four times the dead space. There was no significant difference in the arterial and venous aPTT results in the group in which six times the dead space volume was discarded.

Gregersen, Underhill, Detter, Schmer, and Lax (1987) conducted a study to determine the minimum discard volume necessary to obtain accurate coagulation studies. A sample of 30 patients with radial artery lines in place was used. A series of five 4.5 ml samples was drawn from each patient after a discard volume of the 0.6 ml dead space volume. The only significant difference between the arterial and venous control samples occurred with the arterial sample drawn after a discard volume of 0.6 ml which was the dead space volume. The samples drawn after a 5.1 ml (8.5 times dead space) discard volume or greater showed statistically significant correlation between arterial and venous values. No samples were drawn with discard volumes between the dead space volume and the 8.5 times the dead space volume.

A discard volume of ten times the dead space was used by Kaplow (1988) to compare arterial and venipuncture aPTT results. A sample of 50 consecutive patients admitted to a critical care unit was used for this study. Results of t tests indicated no significant difference in the arterial and venous results. No evaluation was done relative to discard volumes of less than ten times the dead space.

Rakowski-Reinhardt, Tonneson, and Crabtree-Goodnough (1987) conducted studies in a dog lab with 9 subjects to determine the minimum discard volume necessary to obtain accurate coagulation studies. The dead space from the catheter tip to the stopcock was .65 ml. The initial discard volume was 1.3 ml or twice the dead space volume. Seven

subsequent 2 ml samples were drawn as well as a venous control sample. The results indicated that a minimum discard volume of 5 times the dead space volume is necessary to free the sample of heparin contamination. The researchers acknowledged the limitation of the canine model used in the study as the canine coagulation times are shorter than human coagulation times.

Rudesill and Moore (1989) studied the relationship between arterial and venous aPTT results in 30 patients after percutaneous transluminal coronary angioplasty. All the patients in this study were receiving intravenous heparin infusions as a part of the post angioplasty procedure protocol. Both four and six ml discard volumes were used in this study. The results of the study indicated that the minimal amount of discard volume required for reliability of aPTT values is six times the dead space of the catheter.

#### Method of arterial blood draw

The effects of methods of drawing arterial samples for coagulation studies were studied by Cannon, Arrington, and Fabian (1985) and Cicala, Cannon, Larson, and Fabian (1988). Cannon randomly assigned 50 critically ill patients to two groups to evaluate two methods of drawing the arterial samples. Venous samples were used as controls. Method "A" involved a discard volume of twice the dead space before a sample was drawn from the stopcock. In Method "B", two stopcocks were used with the dead space being calculated

from the distal (farthest from patient) stopcock. A syringe was attached to the distal stopcock and 4 ml (dead space) was withdrawn but not discarded. The proximal stopcock was opened to allow blood to drip on to a piece of gauze to clear the stopcock. The sample was then drawn from the proximal stopcock after which the fluid from the syringe in the distal stopcock was reinjected into the system. Very good statistical correlation between the arterial and venous samples was obtained by both methods.

Cicala et al. (1988) examined the accuracy of coagulation studies from heparinized arterial lines using the recently developed Lab-Site (Abbott Critical Care, North Chicago, Illinois) high pressure tubing which was designed to be used with arterial pressure monitoring systems. The system has distal and proximal sampling ports instead of utilizing stopcocks. The procedure to draw blood is similar to that used in Method "B" in the study by Cannon et al. (1987) in which blood is withdrawn to the distal port and the sample from the proximal port. The two major differences between the systems are that no blood is actually withdrawn from the distal port and the system remains a closed system since stopcocks are replaced by sampling ports. The sampling ports are specifically designed for drawing blood and are permanently placed at precalculated distances to allow drawing of accurate samples. Cicala (1988) studied 25 patients in intensive care units who had indwelling arterial lines inserted during their hospitalization. Protime and

aPTT studies were drawn from the line with two venipuncture samples used as controls. The comparison of the arterial and venous samples demonstrated an excellent correlation.

The Lab-Site high pressure tubing offers advantages to both patients and nursing staff. The elimination of stopcocks and the opening of the arterial line system decreases the potential of the arterial line system as a source of nosocomial infection. Stopcocks and opening of the system have been cited as potential sources of contamination (Abbott, Walrath, & Scanlon-Trump, 1983; Spaccavento & Hawley, 1982; Walrath, Abbott, Caplan, & Scanlan, 1979; Yannelli, 1988). The elimination of the blood discards limits the exposure of the critical care nurse to blood and limits a source of blood loss in patients having frequent blood sampling.

#### Effects of systemic heparinization

Systemic heparinization of the patient was noted as a concern by Pryor (1983). The warfarin and subcutaneous heparin did not significantly alter the difference between the arterial and venous aPTT results, but in two patients receiving intravenous heparin the PT and aPTT results were altered considerably. No conclusions could be made since there were only two patients, but neither could the concern be eliminated. Molyneaux et al. (1987) noted no significant difference in the arterial and venous studies between the 5 patients receiving either subcutaneous or intravenous heparin and the 15 patients receiving no heparin therapy.

The advent of new tubing systems and the varied results of previous research indicate that further studies are necessary. The establishment of reliable procedures for drawing coagulation studies from arterial lines is necessary for patient safety as these results are used to guide anticoagulation therapy and evaluate coagulation disorders.

Conceptual Framework

Previous research studies have identified several variables that potentially have an impact on the accuracy of aPTT results. A basic differentiation in many studies is between samples drawn by arterial line or by venipuncture. Variables studied relative to the arterial line values include the amount of heparin in the flush solution, the discard volume, method of arterial line drawing, type of arterial set up and systemic heparinization.

The model illustrating the relationship of the variables is displayed in Figure 1.

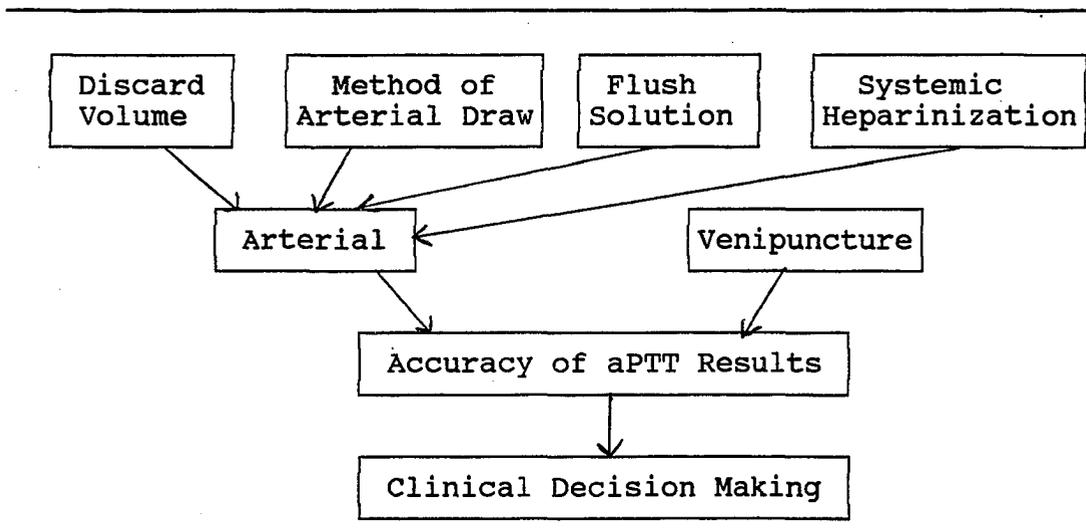


Figure 1. Conceptual Framework

The clinical significance of accurate coagulation studies is the impact of these values on clinical decision making. Suchman and Griner (1986) define the uses of Protime and aPTT studies as screening for coagulation disorders, evaluating abnormal bleeding, and monitoring anticoagulation therapy. Suchman and Griner identify blood drawn from intravenous or intra-arterial heparinized lines as a possible cause of false positive aPTT results.

Griffin (1990) recommends venipuncture specimens for aPTT studies when the results are to be used for diagnosing a bleeding disorder or regulating heparin therapy due to the vigorous debate over the accuracy of coagulation studies drawn from heparinized radial artery catheters. Concern related to blood loss associated with discard volume was also cited as a negative outcome of arterial line blood drawing techniques.

Thrombus formation is a threat to critically ill patients, particularly if there are multiple invasive lines present. Anticoagulation, both prophylactic and therapeutic, is guided by aPTT results. Inaccurate values could result in over or underdosage of heparin which may negatively impact patient outcome.

This study examined the specific arterial line set up and method of arterial line draw as compared to the venous control results of the aPTT studies. The amount of discard was a constant due to the fixed distance of the sampling ports from the catheter tip. Flush solution and systemic

heparinization are not included as these are the same for the entire sample.

The hypothesis of this study was: There is significant correlation between arterial and venous aPTT results with the Lab-Site pressure tubing. The null hypothesis was that there is no significant difference between arterial and venous aPTT results with the Lab-Site pressure tubing.

CHAPTER 3  
METHODOLOGY

Study Design

This was an evaluation study using a correlational design which utilized a convenience sample of 25 patients undergoing elective coronary artery bypass grafts or valve replacement procedures. The proposal for the study received Human Subjects approval from Grand Valley State University and had been approved by the Nursing Research and the Human Research and Clinical Investigation Committees of a 426 bed hospital in western Michigan prior to initiating the study.

Sample

The convenience sample was made up of 25 patients undergoing elective open heart surgery who agreed to participate in the study. The subjects' names and surgical dates were obtained from the hospital surgery schedule and by communication with the Pre-Surgical Testing staff. Informed consent was obtained from the patient or the responsible family member (see Appendix B - Explanation of the Study and Consent Form). The patient demographic data was kept confidential by the researcher and the individual data collection records were destroyed after the study was complete.

The eligibility criteria for inclusion in the study are presented in Table 2.

Table 2

Eligibility Criteria for Inclusion in the Study

---

To be included in the study the participant met the following criteria:

1. Age 18 years or older.
  2. Either patient or responsible family member able to give informed consent.
  3. Scheduled for elective open heart surgery.
  4. Radial artery catheter in place with flush solution of 500 ml Normal Saline with 2000u Heparin.
  5. aPTT ordered by physician.
  6. aPTT to be drawn between 0630 and 1200 Tuesday through Friday.
  7. Patient not previously included in the study.
  8. Veins available for venipuncture. If unable to obtain specimen with one venipuncture, the patient was excluded.
  9. Minimum of 8 hours post operative at the time of the aPTT draw.
  10. Hematocrit  $\geq$  25%.
  11. Patients were excluded who were supported by ventricular assist devices or extracorporeal membrane oxygenators, or who had hemophilia, DIC, or had experienced post operative bleeding.
-

The eligibility criteria serve to provide a more homogeneous sample by eliminating patients with known coagulation abnormalities or patients with a problematic post-operative course. The limitations on the timing of the blood drawing was by mutual agreement between the researcher and laboratory personnel.

### Procedures

This study examined the correlation between arterial and venous aPTT results using the Lab-Site arterial line set-up. This method utilizes the Lab-Site high pressure tubing (Abbott Laboratories, North Chicago, Illinois) in which the blood is drawn to within one inch of the distal sampling port with the sample then being drawn from the proximal port. The sample obtained by venipuncture served as the control.

All patients undergoing elective cardiac surgery have an Arrow 20 gauge 1 3/4 inch catheter placed in the radial artery prior to surgery unless femoral lines were previously inserted. The radial artery catheter was connected to the Abbott Critical Care disposal transducer with the Lab-Site pressure tubing attached. The blood sampling system is designed for use with catheters with priming volumes of 0.2 ml or less. The priming volume of the Arrow 20 gauge 1 3/4 inch catheter is 0.05 ml. Patency of the system was maintained with a flush solution of 2000 units heparin/ 500 ml 0.9 normal saline infusing at 3 ml per hour. The

arterial blood samples were drawn by the Cardiac Surgical Unit RN's after reviewing the protocol with the researcher.

The Lab-Site high pressure tubing is specifically designed to be a part of an arterial pressure monitoring system. The tubing is 152 cm in length and has an internal diameter of .17 cm. The tubing has two sampling ports, a white distal port for clearing the line and a red proximal port for sampling blood. When blood is withdrawn to within one inch of the white port and blood drawn from the red port, it is equivalent to a 3 ml discard volume. The dead space volume from the blood sampling port was 0.35 ml; therefore the discard volume for this system was 8.57 times the dead space volume. The procedure for drawing the specimens from the Lab-Site tubing is detailed in Table 3.

The venipuncture was performed by laboratory personnel. The venipuncture was made after a tourniquet had been in place no longer than one minute. The venipuncture sample was allowed to self-fill the 5 ml blue top Vacutainer and then was transported to the laboratory with the arterial sample.

Table 3

Procedure for Drawing the Specimens From the Lab-Site Tubing

---

1. Manually flush system prior to sample withdrawal.
2. Cleanse both sampling ports with alcohol.
3. Turn stopcock at transducer off to the flush system.

Table Continues

4. Insert a #22 gauge needle attachment to a 10 ml syringe into the white sampling port and withdraw until blood is within 1 inch of the white port.
  5. Insert a #22 gauge needle attached to a 5 ml syringe into the red sampling port and withdraw 5 ml blood.
  6. Withdraw both syringes from sampling ports.
  7. Turn transducer stopcock to original position and flush the line.
  8. Insert needle of the sample syringe into blue topped 5 ml vacutainer and allow tube to self fill.
  9. Label specimen and take to laboratory along with the venous control sample.
  10. Dispose of both syringes and needles in the appropriate container without recapping needles.
- 

Any paired sample in which hemolysis occurred in either the arterial or venous sample was deleted from the study. If bruising was noted at the venipuncture site, direct pressure was applied to the site until oozing stopped.

The laboratory analysis was done within two hours of the draw and the specimens were run sequentially. The arterial specimen results were reported to the critical care unit since the previous aPTT results were obtained from an arterial sample. The control sample results were recorded and the results sent to the researcher.

## CHAPTER 4

### RESULTS

#### Characteristics of Subjects

The sample was comprised of 25 patients undergoing elective cardiac surgery. Seventeen subjects were male and 8 were female. The age range was 39-82 years with a mean age of 65.96 years. Only one subject had been treated with anticoagulants prior to the surgery and the oral anticoagulants had been discontinued 4 days prior to the procedure. Of the 25 subjects, 19 had coronary artery bypass grafts, 5 had aortic valve replacement and 1 had a mitral valve replacement. All data collection was done on the morning following the surgical procedure.

#### Data Analysis

The results of the 25 paired samples are displayed in Table 4.

Table 4

#### Individual aPTT Values Obtained for Intra-arterial Line and Venipuncture Samples

Patient No.	Arterial	Venous	Difference (A-V)
1	29.6	27.6	2.0
2	22.7	22.8	-0.1

Table continues

---

Patient No.	Arterial	Venous	Difference (A-V)
3	23.6	23.6	0.0
4	34.2	32.6	1.6
5	24.8	24.2	0.6
6	30.8	30.0	0.8
7	28.0	25.0	3.0
8	28.3	28.4	-0.1
9	30.4	30.3	0.1
10	26.2	26.0	0.2
11	27.4	29.0	-1.6
12	24.1	23.9	0.2
13	32.3	29.3	3.0
14	27.6	27.7	-0.1
15	29.5	30.4	-0.9
16	46.4	26.7	19.7
17	21.3	20.9	0.4
18	22.0	21.4	0.6
19	25.5	24.7	0.8
20	27.5	26.4	1.1
21	23.7	22.3	1.4
22	26.7	24.8	1.9
23	28.5	27.7	0.8
24	28.1	27.0	1.1
25	28.6	26.9	1.7

---

The mean difference between the arterial and venous results was 1.49 seconds with a standard deviation of 3.925. A histogram was developed for the differences between the arterial and venous aPTT results (Figure 2). Twenty-two of the paired samples had differences within the range of 0 - 2.0 seconds. Two of the differences between the arterial and venous samples were within 2.1 - 3.0 seconds. One of the paired samples differed by 19.7 seconds.

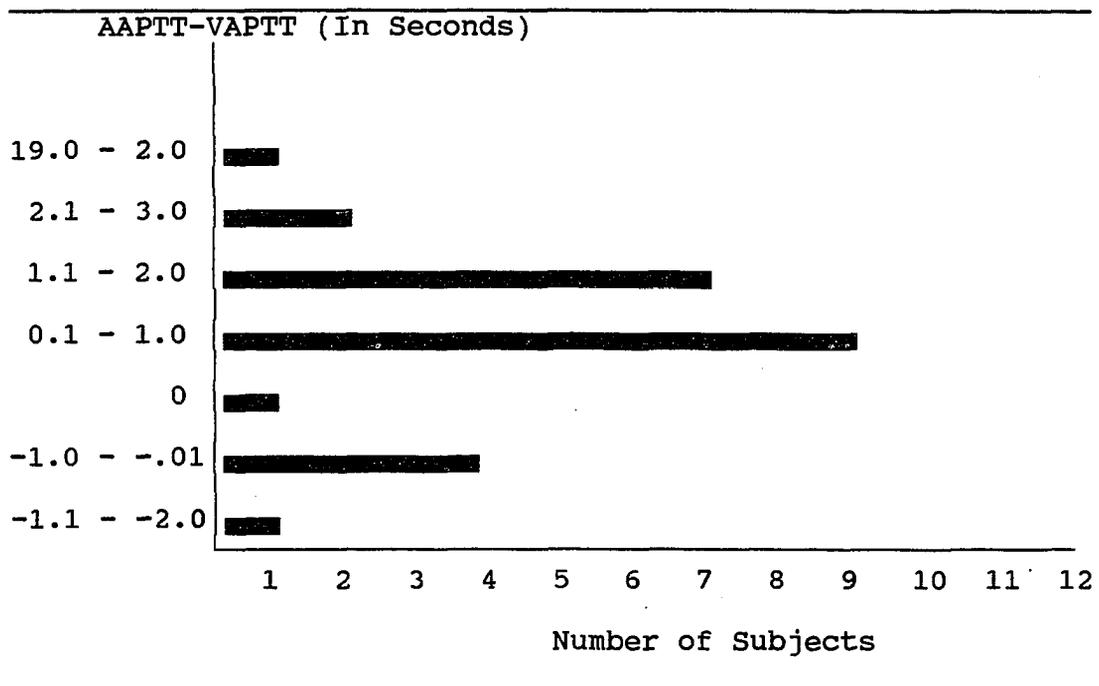


Figure 2. Arterial aPTT - Venous aPTT Differences

The paired t-test was used to determine whether a significant difference existed between the arterial and venous values.

Table 5

Comparison of Arterial and Venous aPTT Values by

Paired t-test

	Mean (sec)	SD (sec)	t Value
Arterial	27.91	4.994	
Venous	26.41	3.008	
Difference	1.496	3.925	1.91

The t value of 1.91 did not exceed t required (2.064, df = 24, p < 0.05), indicating no statistically significant difference between the arterial and venous aPTT values using the Lab-Site high pressure tubing. Therefore, the null hypothesis was accepted. The 95% confidence intervals for the aPTT means from venous and arterial samples are displayed in Figure 3.

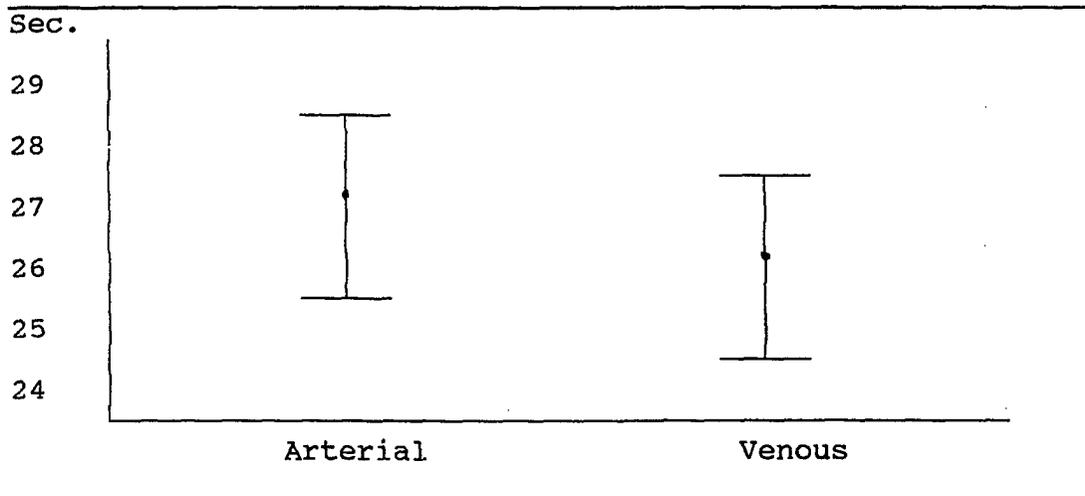


Figure 3. Comparison of 95% confidence intervals for mean aPTT results from arterial and venous samples (n = 24).

The Pearson product moment correlation coefficient was used to determine the strength of the correlation between the arterial and venous aPTT values. The correlation was 0.62 which indicates good correlation between the arterial and venous values. When the one individual with the 19.7 second arterial/venous difference was removed from the sample, the correlation of .95 resulted. No known cause was able to be determined for the discrepancy between the arterial and venous results for subject #16.

The results of the Pearson product moment correlation coefficient indicate good correlation between arterial and venous aPTT results. These results are consistent with previous research studies which indicated that arterial lines containing a heparinized flush solution can be used to obtain aPTT studies if a sufficient amount of discard is used. The Lab-Site pressure tubing used in this study provided the equivalent of a discard volume of 8.5 times the deadspace volume.

#### Other Findings of Interest

The Lab-Site pressure tubing system is designed to minimize blood exposure to the nursing staff and eliminate unnecessary blood loss for the patient by eliminating the actual discarding of the patient's blood. The nursing staff noted difficulties in minimizing blood exposure because the rubber diaphragm at the sample port often spurted blood when the needle was withdrawn. The elimination of the actual

discarding of a patient's blood was viewed as a positive aspect of this particular system.

CHAPTER 5  
DISCUSSION

Discussion

The results of this study indicate good correlation between aPTT results drawn from arterial lines versus results drawn by venipuncture. As demonstrated by this study, there was no significant difference between the arterial and venous aPTT results; therefore, the Lab-Site pressure tubing system appears to be an acceptable method for obtaining accurate aPTT results when used according to the manufacturer's guidelines.

The discard volume in this study was 8.5 times the dead space volume. The results of this study are consistent with the study of Gregerson et al. (1987) which indicated that a discard volume of 8.5 times the dead space volume was sufficient to provide accurate aPTT results.

Molyneaux et al. (1987), Kaplow (1988), and Rudesill & Moore (1989) recommended a minimum discard of six times the dead space to provide accurate aPTT results. Due to the predetermined drawing ports of the Lab-Site pressure tubing and the specific arterial catheter that was used, a discard volume of less than 8.5 times the dead space was not able to be tested.

The method of arterial blood draw in this study was similar to the study by Cicala (1988) which used the Lab-Site pressure tubing. The correlation coefficient of the arterial and venous aPTT samples was of .94 in the Cicala study (1988). The correlation coefficient obtained in this study ( $r = .62$ ) was not as strong a correlation as the Cicala study; although when the one individual with the 19.7 second arterial venous difference was removed from the sample, the correlation of .95 resulted which supports the findings of Cicala (1988). This individual sample appeared to be an outlier and appropriate for elimination, although it would have been useful to identify the reason for such an unusual discrepancy.

The mean difference between the arterial and venous aPTT results was 1.496 seconds. This variance is not statistically or clinically significant, which validates the appropriateness of obtaining coagulation studies from indwelling arterial catheters when specific procedures are followed.

#### Application to Practice

The application of any system such as Lab-Site which has a predetermined discard volume must be done cautiously within the critical care setting. The manufacturer is very explicit in specifying that the system is only intended for use with catheters with a dead space volume of 0.20 ml or less. If a pre-measured system is introduced into a hospital, care must be taken to establish the dead space

volumes of all potential catheters that may be used with an arterial monitoring system to determine which catheters meet the specifications of the arterial line blood drawing system. Failure to do so could lead to inaccurate laboratory results for aPTT tests and potentially other laboratory tests drawn from the line.

The use of closed arterial systems that decrease potential bacterial contamination, decrease exposure of health care providers to blood, and eliminate the discarding of patient's blood are all positive aspects to be considered in the selection of a high pressure monitoring system by an organization. Careful evaluation of a product's claims and review of relevant research should be part of the decision making process. As more products of this nature become available, additional research is necessary to ensure that laboratory results from specimens drawn from the line have an acceptable degree of accuracy.

#### Limitations of this Study

This study was conducted in a midwestern hospital of 426 beds. The data was collected on post-operative cardiac surgery patients who consented to participate. The homogeneous sample limits the ability to generalize the results to different populations such as patients receiving systemic anticoagulation.

The arterial specimens were drawn by the registered nurses working in the critical care unit. The nurses were provided inservice education on the specific technique for

obtaining the specimens. The study would have been more tightly controlled had one individual drawn all the arterial specimens; however, the use of multiple persons to perform the procedure is a more accurate reflection of actual practice and the results are more indicative of what would occur on a daily basis outside of the research study.

The sample size of 25 paired samples was not as large as some of the studies cited in the review of literature. Research studies which involve the cooperation of multiple hospital departments pose particular difficulties for the researcher. The small sample size limits the ability to generalize the results to other organizations or patient populations. The use of a specific arterial line system with a procedure for obtaining blood specimens also limits the ability to generalize the results to other types of systems.

#### Suggestions for Further Research

The introduction of additional closed arterial line systems with different mechanisms for obtaining blood samples stimulates the need for independent research to validate the manufacturer's recommended procedures for obtaining blood specimens. Since coagulation studies are susceptible to contamination by the heparin in the flush solution, aPTT results are a valuable tool in establishing the appropriateness of a specific procedure for obtaining specimens from these catheters.

The use of femoral artery catheters as indwelling arterial pressure lines is another area that is open for research. Since these lines have larger dead space volumes than radial arterial lines, specific procedures must be developed and studied to validate whether results drawn from these lines correlate closely enough to venous results to be acceptable in clinical decision making.

As different invasive lines and different arterial pressure tubing and drawing systems become available more research is needed to ensure that blood drawing procedures provide uncontaminated specimens for analysis. It is critical that clinicians review the relevant research and establish appropriate procedures for obtaining blood specimens to prevent clinical decisions being made on faulty data.

**LIST OF REFERENCES**

---

## References

- Abbott, N., Walrath, J., & Scanlon-Trump, E. (1983).  
Infection related to physiological monitoring: Venous  
and arterial catheters. Heart and Lung, 12(1), 28-34.
- Cannon, K., Arrington Mitchell, K., & Fabian, T. (1985).  
Prospective randomized evaluation of two methods of  
drawing coagulation studies from heparinized arterial  
lines. Heart and Lung, 14(4), 392-395.
- Cicala, R., Cannon, K., Larson, J., & Fabian, T. (1988).  
Evaluation of coagulation studies from heparinized  
arterial lines with use of Lab-Site high-pressure tubing.  
Heart and Lung, 17(61), 662-666.
- Gregersen, R., Underhill, S., Detter, J., Schmer, G., & Lax,  
K. (1987). Accurate coagulation studies from heparinized  
radial artery catheters. Heart and Lung, 16(6), 686-692.
- Griffin, K. B. (1990). Post operative bleeding: Current  
nursing management. Critical Care Nursing Clinics of  
North America, 2(4), 549-557.
- Henry, M. L., Garner, W. L. & Fabri, P. J. (1986).  
Iatrogenic anemia. The American Journal of Surgery,  
151(3), 362-363.

- Kajs, M. (1986). Comparison of coagulation values obtained by traditional venipuncture and intra-arterial line methods. Heart and Lung, 15(6), 622-627.
- Kaplow, R. (1988). Comparison of two techniques for obtaining coagulation studies: Venipuncture and intra-arterial line. Heart and Lung, 17(6), 651-653.
- Molyneaux, R., Papciak, B., & Rorem, D. (1987). Coagulation studies and the indwelling heparinized catheter. Heart and Lung, 16(1), 20-23.
- Palermo, L., Andrews, R., & Ellison, N. (1980). Avoidance of heparin contamination in coagulation studies drawn from indwelling lines. Anesthesia and Analgesia, 59(3), 222-224.
- Pryor, A. (1983). The intra-arterial line: A site for obtaining coagulation studies. Heart and Lung, 12(6), 586-590.
- Rakowski-Reinhardt, A., Tonneson, A., & Crabtree-Goodnough, S. (1987). Minimum discard volume from arterial catheters to obtain coagulation studies free of heparin effect. Heart and Lung, 16(6), 699-705.
- Ruddesill, P. T. & Moore, L. A. (1989). Relationship between arterial and venous activated partial thromboplastin time values in patients after percutaneous transluminal angioplasty. Heart and Lung, 18(5), 514-519.

- Spaccavento, L. & Bradford-Hawley, H. (1982). Infections associated with intra-arterial lines. Heart and Lung, 11(2), 118-122.
- Suchman, A.L., & Griner, P. F. (1986). Diagnostic uses of activated partial thromboplastin time and prothrombin time. Annals of Internal Medicine, 104(7), 810-816.
- Walrath, J., Abbott, N., Caplan, E. & Scanlan, E. (1979). Stopcock: Bacterial contamination in invasive monitoring systems. Heart and Lung, 8(1), 100-104.
- Yannelli, B. & Gurevich, I. (1988). Infection control in critical care. Heart and Lung, 17(6), 596-600.

APPENDIX A

aPTT Research Study  
Participant Data Sheet

Addressograph

Date \_\_\_\_\_ Time \_\_\_\_\_ of Specimen Collection

1. Sex 1. Male \_\_\_\_\_ 2. Female \_\_\_\_\_

2. Age:

3. Diagnosis/Surgical Procedure

4. Previous Use of Oral Anticoagulants

(Prior to hospitalization):

1. No \_\_\_\_\_

2. Yes \_\_\_\_\_ Type: \_\_\_\_\_ Last dose Date/time

a.

a.

b.

b.

c.

c.

5. Bleeding History

1. No \_\_\_\_\_

2. Yes \_\_\_\_\_ Specify type: \_\_\_\_\_

6. Use of Oral/Parenteral Anticoagulation

(This hospitalization):

1. No \_\_\_\_\_

2. Yes \_\_\_\_\_ Type \_\_\_\_\_ Dosage \_\_\_\_\_

Last Dose \_\_\_\_\_

7. aPTT results: Arterial \_\_\_\_\_ Venous \_\_\_\_\_

**APPENDIX B**

## EXPLANATION OF THE STUDY

When people are in an intensive care unit, it is frequently necessary to test the clotting time of their blood so that appropriate therapy can be given. In an effort to avoid having to puncture a patient's vein a number of times during a day, the blood samples are often taken from a radial artery catheter (a catheter inserted in the forearm which remains in place for a period of time) when one is in place. There is some question about whether blood from a catheter produces the most accurate results.

A study is being conducted to determine whether the results of the tests on blood drawn from a catheter are different from blood drawn directly from a person's vein. Fifty open heart surgery patients for whom clotting time tests have been ordered, and who have radial artery catheters in place are being asked to consent to participate in the study. The difference from the routine method of collecting blood is that a single 7 ml of blood will be obtained by venipuncture (the usual method of obtaining blood when a catheter is not in place). The withdrawal of a extra 7 ml of blood should not harm the patient. The only risk to the patient might be a temporary discomfort at the site of the venipuncture and the possibility of bruising at the site. Care will be taken to reduce these risks.

Participation in this study is strictly voluntary and the decision to participate or not participate in the study

will in no way affect the care received from Borgess Medical Center. Participants will not be asked to pay for the cost of the collection and analysis of the additional blood sample.

This study has been reviewed and approved by the Nursing Research Committee and the Human Research and Clinical Investigation Committee of Borgess Medical Center; however, compensation will not be authorized by Borgess Medical Center for any injury resulting from participation in this study.

CONSENT FORM

I understand that the purpose of this study is to compare the results of tests for clotting time on blood samples drawn from a radial catheter with samples drawn through the routine venipuncture procedure.

I further understand that:

1. I have been asked to participate in this study because I have a radial artery catheter in place and tests to measure the clotting time of my blood have been ordered;
2. Participation in the study is entirely voluntary and will in no way affect the care I receive at Borgess Medical Center;
3. The RN researcher will draw a 5 ml blood sample from the catheter and the laboratory technician will obtain one 7 ml of blood by venipuncture;
4. The venipuncture is not expected to harm me but may result in a slight, temporary pain at the site and/or some bruising. Borgess Medical Center will not provide compensation for any injury occurred as a result of this study;
5. I will not be expected to pay for the extra blood sample or its analysis;
6. I will not be identified by name as a participant in this study if the results are presented in the scientific literature;

7. While participation in this study may not benefit me directly, the information gained may help to identify the best method for obtaining blood samples to accurately test clotting time for patients in critical care units.

I acknowledge that:

1. I have been given an opportunity to ask questions regarding this study, and these questions have been answered to my satisfaction. I may contact Lois Van Donselaar, RN, at 383-8280 if I think of further questions. For further information regarding patients' rights in research studies, I may contact Dr. Bailey at the Medical Staff Office at 383-4879.
2. I may change my mind at any time and decide not to participate.
3. I have read and understand the above information and agree to participate in this study. I have received a copy of this document for my own records.

---

(Patient or Guardian)

---

(Witness)

---

(Relationship if other  
than Patient)

---

(Date)