Venous Access Devices: Obtaining Coagulation Tests in Adult Inpatients With Cancer

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Most patients with cancer require the insertion of a venous access device (VAD) during the course of cancer treatment. As a routine, heparin is instilled regularly into VADs to prevent clotting and maintain patency. Blood samples needed from patients with VADs usually are obtained from the devices by RNs according to established protocols. This practice limits unnecessary venipunctures, which can be uncomfortable for patients and, in some cases, very difficult because of the size and integrity of patients’ veins. But when specific types of blood samples are required, such as those related to coagulation, the heparinized solution might affect results. To ensure accurate laboratory results, patients may have to undergo venipunctures.

Palermo, Andrews, and Ellison (1980) concluded that after a 1.5 ml discard volume, accurate coagulation studies could be obtained from a heparinized VAD. Their sample size included only 12 subjects. Ellis (1993) discarded 5 ml prior to blood sampling in 25 subjects and found that accurate activated partial thromboplastin time (aPTT) results could be obtained from VADs if protamine was added to samples; this did not apply, however, to prothrombin time (PT) specimens.

A study by Mayo, Dimond, Kramer, and Horne (1996) (N = 20) concluded that PT, aPTT, and fibrinogen can be drawn from VADs after a 25 ml discard when the objective is to confirm normal coagulation, and that peripheral blood should be drawn for coagulation testing when a critical clinical decision is needed because heparin-free samples are difficult to obtain through heparinized double-lumen VADs. McLarren, Hanna, Mills, Bourdeau, and Cowin (2001) compared three methods of blood sampling for international normalized ratio (INR) values in hemodialysis patients. INR samples were obtained from a peripheral venipuncture site, the central venous catheter (CVC), and the arterial bloodline; variable amounts were discarded depending on the site and type of catheter. Results revealed no significant differences among the three results and concluded that the CVC line and the arterial bloodline are suitable for INR samples. In contrast, four other studies concluded that venipuncture was the only appropriate route for obtaining PT, aPTT, fibrinogen, and fibrinogen degradation products (Almadrone, Godbold, Raaf, & Ennis, 1987 [N = 30, discard 10 ml]; Barton & Poon, 1986 [N = 12, discard 0 ml, 10 ml]; Pinto, 1994 [N = 12, discard 6 x dead space volume]; van Genderen, Gomes, & Stibbe, 1994 [N = 14, discard 10 ml]). Hinds et al. (2002), in a study of 53 pediatric patients with cancer, found that PT, aPTT, and fibrinogen levels obtained from heparinized VADs after 3 ml, 6 ml, and 9 ml discards differed significantly from peripheral samples.

Because existing studies have been inconclusive with small sample sizes and have produced conflicting results, the Oncology Nursing Society (2004) recommended the use of peripheral blood for coagulation studies. Additional evidence-based studies are needed before VAD samples can be used for coagulation studies. Previous researchers have suggested that future studies be designed to include a larger discard volume and that the influence of continuous infusion be

Table 1. Spearman’s Rank Correlation Coefficient Between VAD and Peripheral PT, INR, and aPTT

<table>
<thead>
<tr>
<th>PERIPHERAL AND VAD</th>
<th>SPEARMAN CORRELATION</th>
<th>p*</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT 1</td>
<td>0.985</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>PT 2</td>
<td>0.986</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>PT 3</td>
<td>0.988</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>INR 1</td>
<td>0.985</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>INR 2</td>
<td>0.986</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>INR 3</td>
<td>0.988</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>PTT 1</td>
<td>0.974</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>PTT 2</td>
<td>0.975</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>PTT 3</td>
<td>0.967</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

INR N = 39; aPTT N = 37

*Obtained from testing the null hypothesis that no relationship exists between VAD and peripheral samples; p < 0.05 indicates a significant relationship.

aPTT—activated partial thromboplastin time; INR—international normalized ratio; PT—prothrombin time; VAD—venous access device
investigated (Hinds et al., 2002). Therefore, the purpose of this study was to compare the accuracy of three coagulation tests (PT, aPTT, and INR) performed on blood samples collected from VADs with samples obtained from venipuncture. The following research question guided the investigation: Do differences exist among PT, aPTT, and INR from a specimen drawn from venipuncture compared to a specimen obtained from a VAD after 6 ml, 9 ml, or 12 ml of blood is discarded?

Methods

This was a descriptive, comparative study approved by the institutional review board and consisted of 156 blood samples collected from 39 inpatients with cancer. Inclusion criteria were patients older than 18 years with heparinized VADs who had coagulation tests ordered. Inpatients had to have received an IV fluid infusion for more than 24 hours prior to study blood sampling. Sampling for coagulation studies from heparinized ports is not recommended but acceptable when fluids are infusing (Schallom & Bisch, 2001). Patients were excluded if they were on a heparin drip. Patient consent was obtained to collect blood samples for PT, aPTT, and INR through both venipuncture and a VAD.

The oncology clinical nurse specialist obtained three blood samples of 3 ml each after discarding 6 ml from the VAD and labeled them #1 (equaling a 6 ml discard), #2 (9 ml discard), and #3 (12 ml discard) while the phlebotomist performed one venipuncture. The discard volume is dependent on the volume of dead space and laboratory study desired (Schallom & Bisch, 2001). All samples were sent to the laboratory, and coagulation tests were performed according to standard laboratory procedures.

Spearman’s rank correlation coefficient was used to determine the correlation of PT, aPTT, and INR between the one venipuncture sample and the three VAD samples. The correlation coefficient measure is used to quantify the strength of a relationship between two non-normally distributed variables. The correlation coefficient ranges from -1 to +1, with values close to -1 or +1 indicating a strong negative or positive relationship, respectively. Agreements of sampling results between the venipuncture sample and the three individual VAD samples were measured as bias plus or minus standard deviation.

Results

A high correlation existed between blood samples from peripheral venipuncture and VAD for all tests (see Table 1). No difference existed in results among the three VAD samples, indicating that 6 ml is an adequate discard volume. Figures 1–3 show Bland-Altman plots (Bland & Altman, 1986) highlighting differences between the venipuncture sample and the three individual VAD samples for all coagulation tests. The solid lines represent the bias, which is the average difference between the venipuncture and VAD; the dotted lines represent the limits of agreement (2 × standard deviation of the bias). The plots show very good agreements of sampling results between the venipuncture sample and the three individual VAD samples.

Discussion and Implications

The findings indicate that coagulation test results of blood samples taken from VADs after a 24-hour IV crystalloid solution infusion are as reliable as those from peripheral venipuncture. To prevent interference of heparin present in other catheter lumens with coagulation results, blood sampling from a multi-lumen catheter should be done with all IV infusions turned off. All nonsampling ports without IV infusion should be flushed with 5 ml of normal saline. The sampling port should be the one with IV infusion previously and a discard volume of at least 6 ml withdrawn prior to the collection of coagulation test specimens. This change in practice limits unnecessary venipunctures.

Nurses must be knowledgeable of adequate discard volumes and amounts for accurate laboratory testing, as well as flushing practices prior to blood sampling to ensure best and safe practice. Collaboration with laboratory personnel is critical for implementing a change in practice regarding blood sampling and adhering to policies and procedures. Nurses are obligated to promote psychological and physical comfort in patients. Patients are more at ease with laboratory testing when they are educated on the rationale and processes. In addition, limiting peripheral venipunctures in patients with alternative access devices decreases pain and bruising. Nurses should educate patients about the rationale for various blood tests, including sampling techniques and results. Information should be based on the best evidence available for clinical decision making.
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References

Figure 2. International Normalized Ratio (INR) Agreement Between Peripheral and Vascular Access Device Samples

Figure 3. Partial Thromboplastin Time (PTT) Agreement Between Peripheral and Vascular Access Device Samples