Central Venous Catheter Placement in Patients With Disorders of Hemostasis*

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Objective: **To define the incidence of bleeding complications from central venous access procedures performed by a critical care service in patients with disorders of hemostasis.**
Design: **Prospective, consecutive sample, collection of clinical data.**
Setting: **University teaching hospital.**
Patients: **Seventy-six consecutive patients with disorders of hemostasis who required central venous access for clinical management between October 1992 and October 1993.**
Measurements: **Age, sex, clinical diagnosis, most recent platelet count, prothrombin time (PT), and activated partial thromboplastin time (aPTT) were recorded from the medical record of patients with known coagulation or platelet abnormalities. The site of central venous catheter placement, the number of needle passes necessary to complete the procedure, and the occurrence of complications were reported by the critical care attending physician performing or supervising the procedure.**
Results: **One hundred four central venous access procedures were performed on 76 patients with disorders of hemostasis. Seventy-three percent of catheters were placed in patients with platelet counts less than 100,000/mL and 40% of catheters were placed in patients with abnormalities of PT, aPTT, or both. Thirteen percent of patients had abnormalities of both platelets and coagulation profile. There were no serious complications. Bleeding complicated 7 (6.5% of the procedures; 5 patients had bleeding from the skin (from the suture sites in four), and 2 patients developed small periosteal hematomas. All patients with bleeding complications had thrombocytopenia with mean platelet counts of 22,000/mL and a range of 6,000 to 37,000/mL. Most patients with platelet counts in this range did not have clinically evident bleeding.**
Conclusions: **Central venous access procedures can be done safely in patients with disorders of hemostasis by skilled physicians who frequently perform these procedures. Patients most likely to experience bleeding from these procedures are patients with severe thrombocytopenia. In this series, only a single patient, with a platelet count of 6,000/mL, required therapeutic blood product administration.** ***(CHEST 1996; 110:185-88)***

Key words: central venous catheters; coagulopathy; complications; thrombocytopenia

Abbreviations: aPTT=activated partial thromboplastin time; PT=prothrombin time

Hospitalized patients frequently require central venous access for medication administration or hemodynamic monitoring. Jugular and subclavian vein approaches are frequently preferred.

Patients requiring central venous access often have underlying conditions that increase the risk of bleeding complications. Many physicians are hesitant to perform these procedures because of this greater risk. Correction of bleeding disorders with blood component therapy may decrease these complications but the administration of blood products is not without risk. It is often impractical or impossible to administer blood products prior to obtaining central access.

Our service has placed central venous catheters in patients at a university teaching hospital on a consultation basis for several years. We began doing these procedures in patients with disorders of hemostasis out of necessity. Having experienced no clinically significant complications in these patients, we have altered our criteria for routine central venous catheter placement in patients with bleeding disorders and we do not routinely administer prophylactic blood products.

We now report our experience with central venous access procedures in patients with disorders of hemostasis over a 12-month period.

Materials and Methods

The protocol was approved by the institutional review board as not requiring specific consent for the data collection. Patients re-

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Table 1—*Hemostatic Abnormalities in Patients Undergoing Central Venous Catheter Placement*

Hemostatic Abnormality	Catheters Placed
Platelets >50,000, <100,000/mL	22
Platelets >20,000, <50,000/mL	30
Platelets <20,000/mL	11
PTT >1.2, <1.5 upper limit of normal	4
PTT ≥1.5 upper limit of normal	3 (1>100 s)
PT >1.2, <1.5 midpoint of normal	12
PT ≥1.5×control	6 (3≥20 s)
PT and PTT≥1.5× control	3
Platelet and coagulation abnormal	13

ceived central venous catheters at the request of their primary physician. Except in emergency situations, informed consent was obtained from each patient or his or her surrogate prior to the procedure. For the purpose of this report, disorders of hemostasis are defined as platelet counts less than 100,000/mL, prothrombin time (PT) of 1.2 or greater times the midpoint of the laboratory's normal range or activated partial thromboplastin time of (aPTT) of 1.2 or greater times the upper limit of normal for the laboratory.[1] These indexes were chosen based on the clinical practice patterns at this institution. The laboratory results come from the clinical record. There were no laboratory tests done specifically for this protocol. In all patients, the abnormal laboratory result recorded was that most recent, prior to the time of catheter placement. All patients demonstrated similar abnormalities either prior or subsequent to those utilized in this analysis.

All catheters were placed either by, or under the direct supervision of, one of us (M.E.D. or B.K.). The choice of site for catheter placement was based on clinical judgment. The most recent (within 24 h) platelet and coagulation studies were recorded from the patient's record as were the patient's age, sex, and diagnosis.

The clinical hematology laboratory performed platelet counts by automated counting of EDTA-anticoagulated blood (model STKS; Coulter Electronics Inc; Hialeah, Fla) and the PT and aPTT using reagents (Simplastin XL and Auto aPTT reagent, respectively; Organon Technica; Durham, NC). The laboratory had not yet adopted the international normalized ratio reporting standard at the time of this data collection and PT is therefore reported as multiples of the midpoint of the normal range for the laboratory, 12 s.

Percutaneous insertion of central venous catheters was performed using the modified Seldinger[2] technique utilizing a 2.5-inch, 18-gauge needle and an 0.81-mm diameter guide wire. The catheters placed include 7.0F triple-lumen catheters, 8.5F pulmonary

Table 2—*Hemostatic Abnormalities in Patients With Thrombocytopenia and Disorders of Coagulation Profiles*

Platelet Count, mL	PT, s	aPTT,
68,000	23.3	
73,000	16.0	
72,000	25.0	
45,000	22.6	>100
76,000	23.2	>100
98,000	19.2	
43,000	14.4	
60,000	15.2	
60,000	18.0	47.0
18,000	15.0	
91,000	14.2	
62,000		54.0
83,000	22.5	

Table 3—*Central Venous Catheter Placement in Patients With Disorders of Hemostasis: Anatomic Site of Catheter Placement*

	Catheters Placed	
Catheterization Site		
Subclavian vein	44 Right	39 Left
Internal jugular vein	8 Right	4 Left
External jugular vein	4 Right	2 Left
Femoral vein	2 Right	1 Left

artery catheter introducers, and 12F double-lumen dialysis catheters. The number of needle passes necessary to complete the procedure, defined as forward movements of the needle, was recorded.

At the time of catheter placement, two patients were receiving continuous infusions of heparin and nine were receiving therapeutic doses of warfarin (Coumadin). Although it is our routine to discontinue IV heparin several hours prior to catheter placement, these procedures were considered urgent. One patient with thrombocytopenia had empiric platelet transfusions administered immediately after catheter placement on two occasions (platelet counts 5 and 15). The indication for the catheters was access for platelet administration. None of the patients received platelets or fresh-frozen plasma prior to the procedure, although some may have received platelets at other times to maintain platelet counts of 10,000/mL or greater. Platelets given for this purpose are reflected in the data recorded. At the time of this study, we did not routinely perform subclavian vein cannulation with platelet counts of 20,000/mL or less. Catheters placed otherwise were therefore done without other options. All patients had postprocedure chest radiographs, were examined for evidence of bleeding, and the their nurses were instructed to report any evidence of bleeding or hematoma formation. All untoward events were recorded.

A logistic regression analysis of variables potentially contributing to hemorrhagic complications was completed using a statistical software package (SPSS Version 6.0; SPSS Inc; Chicago). The variables entered were patient age, insertion site, platelet count, PT, and aPTT. All were entered as continuous variables using forward stepwise selection if the significance of the score statistic was less than or equal to 0.05. Variables were removed from the model if the significance of the likelihood ratio test was greater than or equal to 0.10.[3]

Results

Seventy-six patients, 43 male and 33 female, with disorders of hemostasis underwent percutaneous placement of 104 central venous catheters. The mean age of the patients was 59 years and the median age was 57 years. The hemostatic abnormalities and the number of catheters placed in each group are shown in Tables 1 and 2.

The number of catheters placed at each anatomic location is shown in Table 3. In addition, unsuccessful attempts were made for the left subclavian vein in two patients, the right subclavian vein in one patient, the left internal jugular vein in one patient, and the left external vein in one patient. One ICU patient (patient 10, Table 3) had unsuccessful attempts at the right subclavian, internal jugular, and femoral veins before successful cannulation of the left femoral vein. A total of 12 patients with platelet counts less than 20,000 had

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catheters placed. Of these, five were placed in the subclavian vein, four in the internal jugular, and three in the external jugular. Subclavian catheters were placed in 11 of the 13 patients listed in Table 3. One had multiple attempts at multiple sites (as above) and one had a femoral catheter placed at the request of the primary attending physician. The mean number of attempts for successful catheter placement in all patients was 2.25 with a range of 1 to 19 (2 patients with 10 and the patient mentioned above with 19 attempts at 4 sites). Sixty-eight catheters (65%) were placed with a single pass of the needle. Eighteen catheter placements (17%) required 4 or more attempts.

The medical problems of our patients were varied and are shown in Table 4. The patients with congestive heart failure were all receiving warfarin, two of the patients with stroke had anticoagulation, one while receiving warfarin and one while receiving heparin. PTs in the patients receiving warfarin ranged from 15.9 to 18 with a mean of 16.3. The category "other diagnoses" includes the following: hemolytic anemia, colitis, connective tissue disease, endocarditis, mixed cryoglobulinemia, hemoptysis, osteomyelitis, dehydration, pancreatitis, amniotic fluid embolism, and myasthenia gravis. Some patients had 2 diagnoses making the total diagnoses greater than 100% and the sum of catheters and patients greater than the totals for the entire population.

None of these patients developed pneumothorax or other evidence of inadvertent lung puncture. No patient had evidence of intrathoracic bleeding on chest radiograph (defined as new or enlarging fluid collections or enlargement of the mediastinum). No patient experienced an unexplained drop in hematocrit (CBC counts were done as clinically indicated and not specifically for this study). Bleeding at the catheter site complicated 7 catheter placements (6.5%). All seven patients had isolated thrombocytopenia. Five of these patients had bleeding from the skin, related to sutures in four, and the catheter entrance site in one. Two patients developed what clinically were believed to be small (2 to 3 cm diameter) periosteal hematomas of the clavicle. One patient with Kaposi's sarcoma of the skin and a platelet count of 6,000/mL received transfusion of 5 U of donor platelets and required 1 h of direct pressure to stop the bleeding from the skin. For the rest, bleeding stopped with direct pressure for 10 to 20 min. The mean platelet count of the patients with bleeding was 22,000/mL; the median was 21,000/mL with a range of 6,000 to 37,000/mL. All of the catheters were in the subclavian position. Six of the seven were placed on a single pass of the needle; the other required four passes for successful cannulation.

Variables that might significantly contribute to the development of hemorrhagic complications were explored with a logistic regression analysis. The seven patients with bleeding at the insertion site were considered as having had bleeding complications for the analysis. Using a forward stepwise method, four variables, PT, platelet count, catheter site, and the number of passes required to successfully place the catheter, were selected for possible inclusion in a logistic regression model and entered as continuous variables. Only the platelet count entered and remained in the model.

Table 4—*Clinical Diagnoses in Patients Undergoing Central Venous Catheterization and Having Disorders of Hemostasis*

Medical Problem	No. of Patients	(Catheters)
Related to HIV infection	15	(20)
Hematologic malignancy	10	(21)
Renal failure	14	(23)
Solid tumors	12	(13)
Liver failure	8	(9)
Respiratory failure	6	(7)
Congestive heart failure	5	(6)
Stroke	5	(6)
Sepsis	5	(6)
Other diagnoses	11	(16)

Discussion

Access to the central venous circulation is often necessary or desirable in the treatment of hospitalized patients. With bleeding as a potential complication, these procedures are often believed to be contraindicated in patients with disorders of hemostasis unless central access can be achieved via a peripheral vein such as the external jugular or antecubital veins. This approach is usually quite limited.

Correction of the coagulopathy by infusion of blood products is often attempted prior to central venous cannulation to minimize the bleeding risk. This practice carries risk of fluid overload and the transmission of blood-borne infections such as hepatitis and HIV as well as economic expense. Additionally, to our knowledge, there are no published data confirming the benefits of this practice in minimizing bleeding complications.

In our practice, central venous catheters are frequently placed in patients with disorders of hemostasis. This is usually done without the prophylactic administration of blood products. Bleeding problems are uncommon and serious bleeding is rare. Only one patient in this series required more than local pressure for more than 20 min. That patient had a platelet count of 6,000/mL and diffuse Kaposi's sarcoma of the skin. This patient and another with acute leukemia received platelets after the procedure. The first was to stop bleeding from the suture site with platelet count of

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5,000/mL and the second was at the request of the primary attending physician for platelet count of 15,000/mL. In all three cases, the newly obtained central access was the only route for platelet administration.

Our experience confirms and extends the observations of three other recent studies.[4-6] The first[4] describes the safe placement of internal jugular catheters in patients undergoing transvenous liver biopsies. The second[5] involves internal jugular catheter placement in anticoagulated patients undergoing cardiac surgery. The third[6] describes placement of both jugular and subclavian catheters in patients undergoing liver transplantation. All report a very low risk of bleeding complications (1%, 5.4%, and 0%). By the definitions used in two studies,[4,6] the risk of bleeding in our series was zero. The analysis used in the other study[5] was hematoma formation and the result was not different from control and none were clinically significant.

By this report we extend the observations of these previous studies to a much broader patient population. Most of our patients are from the general medical service or ICUs. They are likely to represent the types of patients requiring these procedures in many hospitals. In particular, our patients had frequent thrombocytopenia with a high percentage of patients with HIV and/or malignancies. The specific hemostatic disorders are not published in the other three studies. It is likely, by the populations described, that coagulopathies predominated. In our analysis, the platelet count was the only risk factor statistically associated with even minor bleeding (that requiring direct pressure to stop). The platelet count associated with this risk in our series was less than 38,000/mL (in all but one case the number was $\leq$25,000/mL). Importantly, even patients receiving warfarin did not have bleeding problems, although the PTs were in the lower end of the therapeutic range.

The risk of serious bleeding complications also appears to be independent of the approach used. Most of the catheters in our patients are placed in the subclavian position, which we frequently prefer as it is generally more comfortable for the patient and easier to keep clean.[7]

In all three reports, the operators were experienced in the techniques of central venous cannulation. In ours, an experienced critical care attending physician was involved at all times. Housestaff in training placed many of these catheters with the attending physician present to assist if warranted.

We conclude that central venous cannulation can be safely performed by experienced physicians in patients with disorders of hemostasis. We do not believe that the routine administration of blood products to correct hemostatic abnormalities is warranted under these conditions. Platelets should be available for patients with very low platelet counts in case bleeding is a problem.

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