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Placement of Central Venous Access via Subclavian Vein under Fluoroscopic Guidance with Intravenous Contrast Injection[1]

Sung Wook Choo, M.D., In Wook Choo, M.D., Young Soo Do, M.D.,
Seung Hoon Kim, M.D., Kyu Tong Yoh, M.D., Duk Woo Ro, M.D., Bokyung Kim Han, M.D.

Purpose : To evaluate the safety and efficacy of Hickman catheter placement via the subclavian vein under fluoroscopic guidance with intravenous contrast injection.

Materials and Methods : During an eleven-month period, 187 Hickman catheters were percutaneously placed in 167 consecutive patients in an interventional radiology suite. Subclavian venous puncture was made with injection of contrast medium into the peripheral venous line. After subclavian venous access had been obtained, a subcutaneous tunnel was created using a peel-away sheath or a tunneler. The Hickman catheters were inserted through a peel-away sheath, the distal tip of which was at the junction of the right atrium and the superior vena cava.

Results : One hundred and eighty-six Hickman catheters were successfully placed; the one failure was due to anatomical tortuosity of the vein(0.53%). Complications included one case of subclavian vein occlusion (0.53%); three of line occlusion by thrombus (1.6%); one of oozing at the suture site (0.53%); six of infection or inflammation (3.2%); eight of natural removal (4.2%); one case of air embolism (0.53%) and two of malposition (0.1%). Major complications such as pneumothorax or arterial puncture leading to mediastinal hemorrhage did not, however, occur.

Conclusion : The authors concluded that radiologic Hickman catheter placement offers advantages over traditional approaches in terms of safety, convenience, and time and cost savings.

Index Words : Catheter and catheterization, central venous access
Veins, subclavian

Long-term central venous access has become an important tool in the care of patients with chronic illness. Central venous devices offer convenient access for the administration of chemotherapeutic agents, parenteral nutrition, antibiotics, and blood products. These devices can also be used for frequent blood sampling, sparing patient's psychologic and physical trauma from repeated venipuncture. In recent years, the role of the radiologist in caring for patients requiring long-term venous access devices has been changing, and the number of patients requiring these devices and the consequent problems in maintaining chronic access have increased (1-12). This article documents our experience with Hickman catheter insertion via the subclavian vein under fluoro-venographic guidance in the interventional radiology suite.

Patients and Methods

Between September 1994 and August 1995, 167 consecutive patients were referred to the interventional radiology service for placement of 187 indwelling central venous catheters. Twelve patients had two catheters because of prior catheter malfunction. The group consisted of 103 men and 64 women aged between 15 and 87 years (mean, 54). Indications included the administration of chemotherapy drugs (156 cases, 148 patients with leukemia, lymphoma, multiple myeloma, or other malignancies), total parenteral nu-

[1]Department of Radiology, Samsung Medical Center
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Address reprint requests to : Sung Wook Choo, M. D., Department of Radiology Samsung Medical Center, # 50 Irwon-dong, Kangnam-Ku Seoul 135-230, Korea.
Tel. 82-2-3410-2518 Fax. 82-2-3410-2559

trition (13 cases, 11 patients with Crohn's disease, ulcerative colitis, colonic inertia, pancreatitis, or anorexia nervosa), antibiotic or antifungal administration (three cases, patients with pneumonia, tuberculosis or fever of unknown origin), and nonspecific prolonged needs for venous access in five patients with diabetes mellitus, chronic renal failure or congestive heart failure. The majority were used double-lumen catheters, single-lumen being used for total parenteral nutrition.

Ninety-nine Hickman catheters were placed via percutaneous entry into the left subclavian vein and 88 into the right subclavian vein. One hour before the procedure the patients received 1gm of cefotetan (Jeil, Seoul, Korea) or cefazolin (Chongkundang, Seoul, Korea) as an intravenous bolus for skin flora such as staphylococcus epidermidis, although many of the patients were already receiving antibiotics intravenously. All patients were given prior written, informed consent, which was approved by clinicians.

Radiologic Hickman catheter (Cook, Bloomington, USA) (Fig. 1) placement used a fluoroscopic venographic approach and the patient's nondominant upper lateral chest was used whenever possible. Initially, a small needle was inserted into a vein on the thumb, wrist, hand, or other peripheral location. Patients were laid in the supine position, and the axilla and upper lateral chest were prepared and sterilely draped. After induction with local anesthesia with 2% lidocaine in the upper lateral chest, 30cc of contrast medium (Iopamiro 300, Bracco, Milano, Italy) mixed with 20cc of normal saline was injected until a suitable subclavian vein was filled. The chosen entry vein was punctured under direct continuous vision with a 21 gauge needle by confirming venous blood aspiration. A 0.018-inch wire was then passed into the right atrium through the brachiocephalic vein. A 5-F dilator sheath was subsequently advanced over a guide wire to maintain venous access, and the dilator was capped with a stopcock and flushed with sterile heparinized normal saline.

The location for the subcutaneous tunnel usually corresponded to an interspace about 3cm inferomedially from the puncture site. Local anesthetics were then infiltrated along the chosen track. Two skin incisions, 3cm long in a transverse direction, were made to accommodate the subcutaneous tunneling device. The tunneling tool was bluntly dissected from the track to the temporary venous access site. The Hickman catheter was attached to the back end of the tunneling tool and drawn through this tunnel as far as the Dacron cuff of the catheter located in the midportion of the tunnel. The catheter, which needed to reach the junction of the superior vena cava and the right atrium, was then trimmed to the appropriate length, as measured with a fluoroscopically-guided wire placed intravascularly within the transition dilator.

After achievement of the venous access track with a J-wire, a 12-F peel-away sheath (Cook, Bloomington, USA) was placed. The Hickman catheter was fed and advanced into this sheath (Fig. 2), and the tip at the superior vena cava/right atrial junction was confirmed fluoroscopically in such a way that the tip kicked with each cardiac cycle to prevent thrombus formation around the catheter (Fig. 3). As the Hickman catheter was held firmly in place, the sheath was split and peeled out, and the final small loop of the catheter was buried. All channels of the catheter were irrigated with

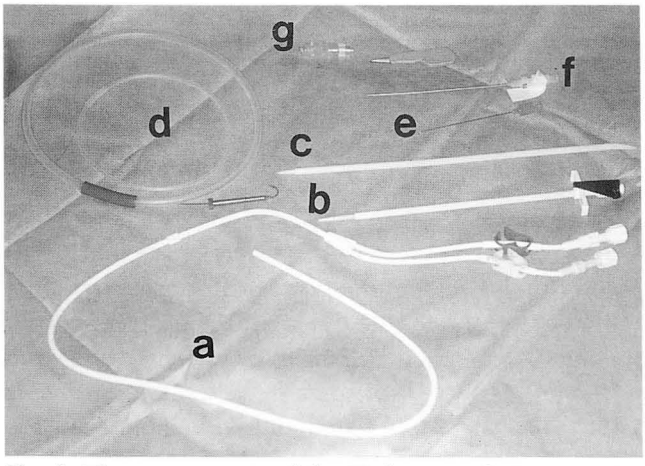

Fig. 1. The components of the Hickman catheter insertion kit are as follows : (a) catheter ; (b) peel-away sheath ; (c) plastic tunneler ; (d) J-wire ; (e) 21-gauge micropuncture needle ; (f) 5F dilator ; (g) catheter caps.

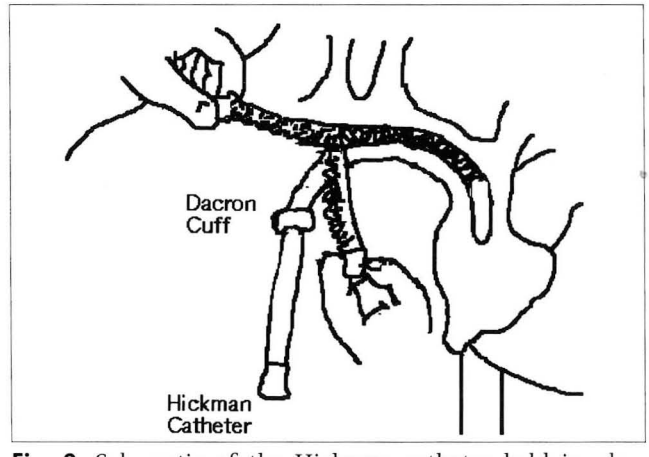

Fig. 2. Schematic of the Hickman catheter held in place while the sheath is split and peeled out.

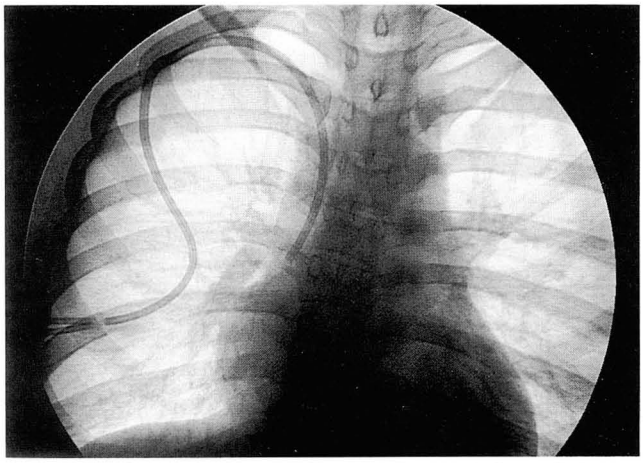

Fig. 3. Hickman catheter placement via right subclavian vein. Catheter tip should be advanced into atriocaval junction and confirmed his own kicking at each cardiac cycle on fluoroscopy to prevent pericatheter thrombus formation.

heparinized saline and the two chest incisions were sutured and the exit site dressed. A postprocedural chest radiograph was always obtained to ensure that pneumothorax or tip malposition or other complications had not occurred and the catheter was finally flushed with a heparin lock solution containing 100U/mL of heparin. This whole procedure normally took 30 minutes or less.

Results

A total of 187 Hickman catheters were used in 167 patients. One hundred and eight-six of 187 initial insertions were successful (99.5%); unless there was a central venous obstruction, confirmed by fluorographic venogram. The one failure was due to anatomical venous tortuosity.

Complications can be divided into two groups: one is technique-related and includes pneumothorax, arterial puncture, pulmonary air embolism and natural removal; the other is related to long-term maintenance and includes vein occlusion, thrombus formation, infection, and malposition of the catheter. Malfunctioning complications in which removal of the catheter is required include vein occlusion, peri-catheter thrombus, bleeding by coagulopathy, infection, and malposition. Complications in our series occurred in 22 patients (11.7%). Six catheters (3.2%) were removed because of infection. In three cases (2.1%), catheter thrombosis was present. Spontaneous removal of the catheter occurred in eight patients (4.2%), and catheter malposition into the internal jugular vein in two. Subclavian vein occlusion by the catheter, oozing at the catheter exit site, and air embolism each occurred in one patient.

Discussion

Central venous devices offer convenient access for the administration of chemotherapeutic agents, parenteral nutrition, antibiotics, and blood products. These devices can also be used for frequent blood sampling, sparing the patient the psychologic and physical trauma of repeated venipuncture. In recent years, the role of the radiologist in caring for patients requiring insertion of long-term venous access devices has been changing, and at the same time the number of patients requiring these devices and the consequent problems in maintaining chronic access have increased (1-12).

In placement technique, the use of a 21-gauge needle for initial puncture in the micro-puncture set can lessen the risk of mediastinal hemorrhage and pneumothorax if perforation of an artery or pleural space should occur, and is therefore to be preferred to the use of 14 or 18-gauge needle during surgical placement (1, 11). By injecting diluted contrast material using the peripheral intravenous line (1, 2), we also overcame the difficulties involved in locating the subclavian vein (1, 2). The required length of the catheter from the entry site to the atrio-caval junction can be precisely measured by intravascular hairwire under fluoroscopic monitor, while surgeons determine the proper length by estimating along the chest wall (1-3, 11). In our series, one case of failed insertion because of venous tortuosity was overcome by using stiff wire and a long peel-away sheath.

Our overall complication rate (22 of 189 (11.7%)) compares favorably with that of other devices and with the surgical or bedside approach (1-5, 8, 9, 12). Without preventive medication for normal skin flora such as Staphylococcus epidermidis, six cases of infection occurred in the early period; the source of this was thought to be the catheter, through the insertion site. After antibiotics for skin flora were administered, catheter exit site infection did not occur. Kicking of the catheter at the atriocaval junction can prevent the possibility of catheter thrombosis. A urokinase dose of 10,000U (diluted with sterile water) may be successful in removing a clot from a malfunctioning catheter and may be repeated up to three times in a 4-hour period (11). Fluoroscopic monitoring has the advantage that tip malposition, pneumothorax or pulmonary air emboli can be promptly detected. Treatment of these complications is more easily accomplished in the interventional radiology suite (2, 11). Spontaneous removal within one week of placement occurred because

of our lack of surgical skill in holding the catheter more firmly in place until it could be anchored by fibrosis into the Dacron cuff can anchor the catheter. Malposition of the catheter can occur when placed in the brachiocephalic veins or proximal superior vena cava, not at the atriocaval junction.

In particular, pulmonary air embolism, which can cause significant cardiovascular instability, may occur if the patient inhales when the dilator of the peel-away sheath and guide wire are removed preparatory to passing the silicone catheter. The risk is minimized if the sheath is gently squeezed shut during removal of the dilator and initial insertion of the silicone catheter, rather than relying on the patient's compliance with breathing instructions. If air embolism does occur, traditional teaching recommends turning the patient right side up to "trap" the air in the right atrium. Vital signs should be continuously monitored and oxygen administered nasally (11).

Finally, the authors conclude that radiologic Hickman catheter placement via the subclavian vein offers great advantages over traditional approaches in terms of safety, convenience, and time and cost savings.

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조영제 정맥 주입과 투시 유도하에 쇄골하정맥을 통한 중심 정맥 도관 삽입술[1]

[1]삼성서울병원 진단방사선과

주성욱 · 주인욱 · 도영수 · 김승훈 · 여규동 · 노덕우 · 김보경

목 적 : 조영제 정맥 주입과 투시 유도하 쇄골하정맥을 통한 중심 정맥 도관 삽입술의 안전성과 효율성을 알아보고자 하였다.

대상 및 방법 : 11개월 동안 167명의 환자에게 187예의 중심 정맥 도관 삽입술을 혈관조영실에서 시행하였다. 말초 정맥에 조영제를 주입하여 투시하에 쇄골하정맥을 천자하였다. 정맥 소통을 얻은 후에, 피하 터널을 탈피초를 이용하여 만들었다. 중심 정맥 도관을 탈피초를 통하여 그 끝이 우심방과 상대정맥이 만나는 부위에 삽입하였다.

결 과 : 186예에서 중심 정맥 도관을 성공적으로 삽입하였고, 1예는 정맥의 사행성으로 실패하였다. 합병증은 1예의 쇄골하정맥 폐색, 3예의 혈전에 의한 도관 폐색, 1예의 봉합 부위 삼출, 6예의 감염, 8예의 자연 제거, 1예의 공기색전증, 2예의 변위였다. 그러나 기흉이나 동맥천자같은 위험한 합병증은 발생하지 않았다.

결 론 : 저자들은 조영제 정맥 주입과 투시 유도하 방사선학적 중심 정맥 도관 삽입술이 종전의 다른 방법보다 안전성, 효율성에서 많은 이점을 줄 수 있다고 결론지었다.