Applying Totally Implantable Venous Access Devices (TIVAD) in Children: the First Iranian Experience

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Abstract

Background: During recent years and paralleling the advances in the treatment of patients requiring chemotherapy or long-term total parenteral nutrition (TPN), it has been necessary to provide a chronic central venous access with a low complication rate and long-term availability (months or even years).
In our country, this procedure is performed and its technique is refined, but its advantages and complications have not been analyzed and reported.

Materials and Methods:
The records of 120 patients who had undergone TIVAD placement in Mofid children's hospital, Tehran from 1999 to 2005 were retrospectively reviewed. Outcomes and compliance of parents and therapeutic team were evaluated.

Results: There were 120 patients, 68 boys (56.6%) and 52 girls (43.3%); with the age range of 3 months to 13 years old. The following postoperative complications were encountered; withdrawal occlusion in 4 patients (3.3%), intraluminal fibrin sheath in one patient (0.8%), severe neutropenia in 3 patients (2.4%), complete intraluminal occlusion of the catheter in one patient (0.8%), fever and chills in 2 patients (1.6%), and catheter dislodgement in only one patient (0.8%). All parents and members of the therapeutic team were pleased with the TIVAD (100% acceptance).

Conclusions:TIVAD placement can be performed in infants and children of all ages. In cases where a chronic venous access is needed, the use of this device is appropriate, because of its low complication rate and long-term applicability.

Keywords: Neoplasms, Total parenteral nutrition, Venous access.

Introduction

One of the main problems that patients with pediatric cancers and also patients requiring long-term TPN encounter is vein irritation due to chemotherapy agents, hyperosmolar solutions, and the type of catheter used. Furthermore, peripheral veins are not easily accessible, especially in younger patients, and are not useful for repeated or continuous infusion. Due to these problems, there is a serious need for a reliable central venous access applicable for long periods (months or years) with a low complication rate. TIVAD offers a new opportunity to solve the problems.[1,2] Fortunately, applying port catheters has become very popular in our country in recent years. Published series depict a low complication rate, few technical problems, and favorable response.

Here, we present our experience with TIVAD in surgery department of Mofid children's hospital.

Materials and Methods

From 1999 to 2005, 120 patients underwent insertion of TIVAD in surgery department of Mofid children's hospital, Tehran, Iran. Only 1 patient required TIVAD due to short bowel syndrome. All other patients were referred from Hematology-Oncology department, and needed long-term administration of chemotherapy or other agents. TIVAD placement was undertaken under general anesthesia. A small supraclavicular incision (2-2.5 cm long) was

performed, and the catheter was inserted via cutdown of the internal jugular vein. Catheter tip was located at the junction of right atrium and superior vena cava. Then, a counter-incision was made on the chest wall for the port (between the 3rd and 4th intercostals space, mid-clavicular line) and a subcutaneous pouch was created. The catheter was tunneled through the subcutaneous pouch to the venous cutdown site and cut to appropriate length. The success of the procedure was documented by gentle injection of normal saline and reflux of blood when aspirated. At the end of the operation, the system was heparinized.

Results

Over the study period, 120 patients were operated with ages ranging from 3 months to 13 years old. Sixty eight (56.6%) patients were male and 52 (43.3%) girls. Seventy one (64%) patients were affected with leukemia, 16 patients (13%) with lymphoma, 4 patients (3.3%) with Wilms' tumor, 7 patients (5.7%) with neuroblastoma, 1 patient (0.8%) with hemangioendothelioma, 1 patient (0.8%) with short bowel syndrome (0.8%), 1 patient (0.8%) with mesenchimal myxoid tumor of the retroperitoneum, 1 patient (0.8%) with maxillary Ewing's sarcoma, 2 patients (1.6%) with hemolytic anemia, 1 patient (0.8%) with retinoblastoma, 6 patients (5%) with germ cell tumor, and tow patients (1.6%) with thalassemia.

Neither bleeding, nor pneumothorax was encountered in our patients. Four patients (3.3%) were presented with withdrawal occlusion relieved without any specific measures. One patient (0.8%) developed catheter malfunction due to an intraluminal fibrin sheath which resolved with thrombolytic injection. One patient (0.8%) had total catheter occlusion; therefore, the device was removed from the right side and placed at the left side. Catheter tip dislodgment into axillary vein occurred in one patient (0.8%) and treated with catheter reinsertion.

Regarding late complications; none of our patients developed venous thrombosis, displacement of the catheter tip, catheter sepsis, catheter tip infection, pain at the incision site, or spontaneous exit of the catheter. Three of our patients (2.5%) developed severe neutropenia 3 months, 4 months, and 16 months after catheter placement, respectively. All of them were presented with skin infection at the incision site. They responded favorably to intravenous antibiotics along with device removal. Two patients (1.6%), one suffering from thalassemia and the other one from acute lymphoblastic leukemia, who underwent an uneventful TIVAD placement developed fever and chills immediately after beginning the intravenous infusion through the device. Diagnostic work-up and cultures were negative for infection. The condition resolved with TIVAD removal.

Finally we performed an inquiry in order to evaluate parents and therapeutic team satisfaction. We divided responses in three groups: non-satisfactory, satisfactory, and totally satisfactory. A hundred percent of totally satisfactory responses were obtained from parents as well as from the therapeutic team.

Discussion

The first generation of indwelling central catheters was made of polyvinyl chloride and was relatively stiff and thrombogenic. These catheters were associated with a number of mechanical and septic complications.[3] In 1973, Broviac and colleagues introduced silastic catheter, an indwelling silicon rubber catheter that can remain in place for extended periods.[4] Silastic catheter is much more flexible, inert, and associated with fewer complications (mechanical occlusion, venous perforation, and infection) than polyvinyl catheter is. Commercial products of these catheters have evolved to the widely used permanent central venous catheter (PCVC).[5] These catheters are manufactured from radioopaque soft silicone robber, in varying calibers and length, and have a small Dacron-felt cuff 30 cm from the external end. The cuff allows fibrous ingrowth, which serves to anchor the catheter and to act as a barrier to infection. Indications for PCVC use in children include any condition requiring long-term venous route for administration of fluids, antibiotics, antineoplastic drugs, TPN, and blood products, or need for frequent blood sampling. Modified versions of these catheters, generally with larger, dual lumens and a 2 to 3-centimeter offset between the ends of the lumens, are used for therapies requiring high flow without recirculation, such as hemodialysis and apheresis. Appropriate candidate for PCVC placement include in-hospital patients, such as infants recovering from gastroschisis or necrotizing enterocolitis, or non-hospitalized patients such as children with neoplastic diseases requiring chemo-

therapy or patients with short bowel syndrome on home parentral nutrition.

Need for a reliable vascular access during long-term intermittent parenteral therapy to further reduce complications of PCVCs was the stimulus for development of a totally implantable venous access device (TIVAD) or port-a-cath.[3] Although centrally placed venous catheters such as PCVC are often used for long-term intermittent infusion therapy, they have obvious drawbacks such as infection, need for attention to sterility during periodic dressing change, restriction of daily activities imposed by the external portion of the catheter, and psychological and aesthetical problems for many patients, particularly teenagers. A variety of totally implantable devices consisting of small-volume subcutaneous injection ports and silastic catheter are now available.[6,7] Indications for TIVADs are similar to those for PCVCs. Miniaturization of these devices has extended their use to infants and small children.

Conclusion

Regarding low rate of complications such as infection and catheter dislodgement, as well as, high compliance of patients, parents, and treatment team, we suggest applying TIVADs in all pediatric patients requiring chemotherapy, long-term TPN, and long-term venous access.

Table 1. Indications for TIVAD in Mofid children's hospital.

Indication	Number of patients (٪)
Acute lymphocytic leukemia (ALL)	71 (59%)
Acute myeloid leukemia (AML)	7 (5%)
Lymphoma	16 (13%)
Neuroblastoma	7 (5.8%)
Wilm's tumor	4 (3.3%)
Hemangoiendothelioma	1 (0.8%)
Mesenchimal myxoid tumor	1 (0.8%)
Ewing sarcoma (maxilar)	1 (0.8%)
Germ cell tumors	6 (5%)
Retinoblastoma	1 (0.8%)
Hemolytic anemia	2 (1.6%)
Thalassemia	2 (1.6%)
Short bowel syndrome	1 (0.8%)
Total	120 (100%)

Table 2. Incidence of complications.

Complication	Number of patients (%)
Withdrawal obstruction	6 (5%)
Infection and skin erosion	3 (2.5%)
Fever and chills coinciding with infusion	2 (1.8%)
Catheter tip dislodgment	1 (0.8%)
Total	12 (10%)

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