INTRODUCTION

The maintenance of central venous access is critical to the management of pediatric patients in various clinical scenarios, and the establishment of vascular access is one of the most common procedures performed by pediatric surgeons. This is of utmost importance particularly in those who are dependent on parenteral nutrition. Although the internal jugular or subclavian vein is an adequate route of access in most patients, a common pitfall associated with long-term venous access is the eventual exhaustion of traditional sites of peripheral or central catheterization over time. This is caused by multiple complications, including catheter sepsis, venous stenosis and/or thrombosis, or catheter malfunction. It is therefore critical to understand the various options for long-term central venous access in these patients. In this chapter, we provide a comprehensive and multidisciplinary approach to the management of reoperative venous access with particular attention to preoperative planning and imaging, as well as specific techniques in interventional radiology and surgery.

PREOPERATIVE PLANNING

Most patients who require long-term vascular access have an associated complex medical and surgical history. In addition to their underlying disease, such patients have also often had complications related to venous access itself. The development of a rational strategy for central venous access is dependent on the recognition of the disease processes most likely to require long-term vascular access and the
identification of suitable vein(s) that will provide extended patency. Patients at high risk of requiring prolonged venous access generally include those with intestinal failure, owing to either quantitative (short bowel syndrome) or qualitative (intestinal dysmotility or long-segment Hirschsprung’s disease) dysfunction. In other patients, the presence of malignancy may require prolonged central venous access for the delivery of parenteral nutrition, chemotherapeutic agents, and/or frequent blood sampling. Therefore, the prevention of central vein occlusion is a critical goal. In these patients, it is important to avoid ligation of major veins during placement of central venous catheters (CVCs). Minimization of the number of CVCs inserted in these patients is also very important. Referring physicians should understand the risks associated with CVC insertion. Although CVCs greatly facilitate patient care in terms of avoiding needle sticks for blood draws and limiting peripheral intravenous lines, future standard insertion sites may be compromised by the overliberal utilization of CVCs.

Central venous catheter replacement in patients requiring prolonged central venous access should be performed only when absolutely necessary. For example, cuts or breaks in the catheter should seldom dictate the need for a catheter replacement, but rather catheter repair kits should be used to preserve CVCs. In addition, catheter patency can usually be reestablished from occlusion owing to drug, clot, or lipid solutions. In order to salvage a CVC, bacteremia can often be managed with a course of antibiotics through the catheter. Finally, it is important to assess the purpose of central venous access. Insertion of a second CVC may be avoided if a schedule is devised to enable medications and/or blood draws to all be done through an existing catheter.

The patient population requiring prolonged central venous access is prone to catheter-related complications. Technical misadventures during CVC insertion may be avoided by eliciting a careful history, which reveals the need for preoperative imaging. Many factors contribute to catheter-related complications, including catheter tip location, duration, and prior catheterization (1,2). The number and sites of previous CVCs, complications from previous CVC insertion, and the presence of coexisting pathology are all key factors that must be considered. In addition, a history of prior head and neck surgery, previous radiation exposure to the mediastinum, or known mediastinal, lower extremity, or abdominal pathology should alert the clinician that standard sites for central venous access may be unsuitable.

The use of preoperative imaging prior to CVC insertion may be guided by physical examination, as such findings are frequently related to central vein occlusion or stenosis. For the upper extremities and torso, signs associated with occlusion of the veins that drain into the superior vena cava (SVC) may be identified. For example, upper extremity edema, prominent collateral veins, varicosities, and plethora are all characteristic of SVC obstruction. Alternatively, if venous return via the inferior vena cava (IVC) is impeded, similar findings of edema and venous hypertension will be evident in the lower extremities.

**PREOPERATIVE IMAGING**

Venous anatomy may be imaged by a variety of modalities, but ultrasound and magnetic resonance venography are the most commonly utilized techniques. In the following section, we discuss the use of these and other radiologic modalities. Figure 1