CAR Standard for the performance of Central Venous Access

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The standards of the Canadian Association of Radiologists (CAR) are not rules, but are guidelines that attempt to define principles of practice that should generally produce radiological care. The physician and medical high-quality physicist may modify an existing standard as determined by the individual patient and available resources. Adherence to CAR standards will not assure a successful outcome in every situation. The standards should not be deemed inclusive of all proper methods of care or exclusive of other methods of care reasonably directed to obtaining the same results. The standards are not intended to establish a legal standard of care or conduct, and deviation from a standard does not, in and of itself, indicate or imply that such medical practice is below an acceptable level of care. The ultimate judgment regarding the propriety of any specific procedure or course of conduct must be made by the physician and medical physicist in light of all circumstances presented by the individual situation.

I. INTRODUCTION

Central venous catheters are important for patients with malignant, infectious and chronic diseases. Image guided placement of central venous access catheters is a safe and effective method because it improves success rates and reduces morbidity and mortality as compared to blind or external landmark central venous catheter insertion.

II. RADIOLOGIST QUALIFICATION

Physicians involved in the performance, supervision and interpretation of Central Venous Access should be Diagnostic Radiologists and should have a Fellowship or Certification in Diagnostic Radiology with the Royal College of Physicians and Surgeons of Canada and/or the Collège des Médecins du Québec. Also acceptable are equivalent foreign Radiologist qualifications if the Radiologist is certified by a recognized certifying body and holds a valid provincial license.

As new imaging modalities and interventional techniques are developed additional clinical training, under supervision and with proper documentation, should be obtained before Radiologists interpret or perform such examinations or procedures independently. Such additional training should meet with pertinent provincial/regional regulations. Continuing professional development should meet with the requirements of the Maintenance of Certification Program of the Royal College of Physicians and Surgeons of Canada.

Image-based diagnosis and treatment planning requires integrating the preprocedural imaging findings within the context of the patient's history and physical findings. Therefore, the physician should be clinically informed and understand the specific questions to be answered, and the goals to be achieved, by Central Venous Access, prior to the procedure in order to plan and perform it safely and effectively. It is also expected that the Radiologist involved will have knowledge of the uses and limitations of various Central Venous Access devices and be aware of alternative procedures, and be able to discuss these alternatives with the patient, or provide guidance about who to discuss alternative therapy with.

The physician performing Central Venous Access should fully appreciate the benefits, and risks of the procedure. He/she should have a thorough understanding of imaging anatomy (including congenital and developmental variants), fluoroscopic and ultrasound equipment, placement procedures for a wide variety of venous access devices, radiation safety considerations, and physiologic monitoring equipment and have access to adequate supplies and personnel to safely perform the procedure.

Physicians should perform a sufficient number of Central Venous Access procedures to maintain their skills with acceptable success and complication rates as laid out in this standard. Continued competence should depend on participation in a quality improvement program that monitors these rates. Appropriate attendance at postgraduate courses that provide continuing education on diagnostic advances, newer techniques, and equipment is recommended.

III. TECHNOLOGIST CREDENTIALS/NURSING SERVICES

The Medical Radiation Technologist should have Canadian Association Medical Radiation Technologist certification or be certified by an equivalent licensing body recognized by the CAMRT.

Under the overall supervision of the Radiologist the Technologist will have the responsibility for patient comfort and safety, for examination preparation and performance, for image technical evaluation and quality, and applicable quality assurance. The training of Technologists specifically engaged in Interventional Radiology shall meet with applicable and valid National and Provincial Specialty qualifications.

Nursing services may be required before, during, and after the procedure for patient care, sedation and monitoring. If a qualified nurse is not available an appropriately trained Technologist may perform some of these functions under the direction of the Radiologist. Adequate numbers of properly trained staff should be available to assist the Radiologist, particularly in the event of an emergency.

Delegation of procedures to Nursing and other non-medical staff:
In many institutions performance of some central venous access procedures is delegated to Nursing (or other non-medical) staff, under the supervision of a qualified Radiologist. In this situation, the institution must have formal written protocols for training, supervision and quality assurance. Success rates and complications should be regularly audited in conjunction with the supervising Radiologist. The Standards outlined in this document should be followed.

IV. INDICATIONS AND CONTRAINDICATIONS

A. Indications

The indications for Central Venous Access include, but are not limited to:

Administration of chemotherapy
Administration of total parenteral nutrition
Administration of blood products
Administration of intravenous medications
Administration of intravenous fluid
Administration of plasmaphoresis
Administration of hemodialysis
For repeated blood sampling

B. Contraindications

The relative contraindications for Central Venous Access include:

A. Known coagulopathy, which cannot be adequately corrected;
B. Inability of the patient to cooperate with, or to be positioned for, the procedure;
C. Known adverse reaction to contrast media when contrast media administration is critical to the safe performance of the procedure;
D. Hemodynamic instability;
E. Lack of a safe pathway to the vessel.
F. Lack of informed consent.

Specific contraindications:

A. Sepsis
B. Venous stenosis or thrombosis
C. Local skin infection

Patient management should address these contraindications prior to the procedure. Every effort should be made to correct or control these clinical situations before the procedure, if feasible.

All imaging facilities should have policies and procedures to reasonably attempt to identify pregnant patients prior to the performance of any diagnostic examination involving ionizing radiation. If the patient is known to be pregnant, the potential radiation risk to the fetus and clinical benefits of the procedure should be considered before proceeding with the study.

V. EXAMINATION TECHNIQUE, PERFORMANCE AND RELATED MATTERS

The procedure is usually performed using ultrasound (US) guidance, with or without, fluoroscopy. US is well suited for Central Venous Access; the initial needle puncture can be guided with US in the angiography suite, which permits fluoroscopic guidance for subsequent guidewire and catheter manipulation. US guidance has been proven to reduce complications related to Central Venous Access and should be used in most instances to reduce the risk of injury to arteries and other structures.

The decision to place a Central Venous Access catheter should be made after considering both the risks and benefits in each case. There are many different types of Central Venous Catheters, including Peripherally Inserted Central Catheters (PICC), temporary central venous catheters and tunneled central venous catheters. PICCs are placed via a peripheral venous route. Other CVCs are placed via a jugular vein, subclavian vein, or femoral vein approach. The jugular vein is generally preferable, when feasible, due to a lower rate of complications. Other venous access sites, including direct inferior vena caval puncture, have also been described and used successfully.

The catheter tip should generally be placed near the cavo-atrial junction utilizing real-time imaging (fluoroscopic guidance). Certain types of tunneled dialysis catheters can be placed in the right atrium and may function better in this location.

Placement of venous ports will require the operator to be knowledgeable about simple surgical techniques, wound closure, and management of incision site bleeding. The availability of diathermy may be of benefit for these types of procedures.

The catheter exit site or implanted site can be located in several different locations but is usually placed over the torso, neck or peripherally. Other alternative access routes have also been described.

A. Imaging Equipment and Facilities

1. The minimum requirements for facilities in which Central Venous Access is performed include:

a. A high-resolution imaging chain with adequate shielding and collimation is very beneficial for fluoroscopic guidance. Ability to perform complex angle i.e. AP, lateral, or oblique views is often necessary during fluoroscopically guided procedures to ensure proper needle placement. Image and written documentation of catheter tip placement are essential. Overhead fluoroscopic tube suites are less desirable because of increased radiation exposure to personnel during this procedure.

b. Utilization of ultrasound for venous access is highly recommended. Proper transducer frequency is required to direct and monitor needle placement.

c. The facility should provide an area within the institution appropriate for patient preparation prior to the procedure and for observation of patients after the procedure. This might be within the radiology department, in a short- stay unit, or on a routine nursing unit.

d. For patients undergoing thoracic procedures, a full array of percutaneous c atheterization equipment for treatment of pneumothorax should be available.

e. Physiologic monitoring should include ECG during placement of central venous catheters.

f. Aseptic technique should be practiced to minimize catheter contamination during implantation.

g. Availability of adjunct team members with appropriate training to monitor, and provide sedation to patients as required, is highly recommended.

2. Performance standards

When using fluoroscopy for Central Venous Access, a facility should meet or exceed the following imaging practices:

a. Fluoroscopic time should be kept to a minimum. The operator will use only as much fluoroscopy as is necessary to achieve device placement, consistent with the as low as reasonably achievable (ALARA) radiation safety guidelines.

b. Tight collimation and, when appropriate, shielding (e. g., thyroid, gonadal, etc.).

B. Physiologic Monitoring and Resuscitation Equipment

1. Sufficient equipment should be present to allow for monitoring the patient's heart rate, cardiac rhythm, and blood pressure. For facilities utilizing conscious sedation, a pulse oximeter should be available.

2. There should be ready access to equipment and drugs for emergency resuscitation. The equipment should include an emergency defibrillator with paper recorder and quick- view capability, oxygen supply and appropriate tubing and delivery systems, suction equipment, tubes for endotracheal intubation, laryngoscope, ventilation bag- apparatus, and central venous line sets. Drugs mask-valve for treating cardiopulmonary arrest, contrast reaction, vasovagal reactions, narcotic or benzodiazepine overdose, bradycardia, and ventricular arrhythmias should also be readily available.

C. Surgical Support

Although complications of Central Venous Access only rarely require urgent surgery, these procedures should be performed in an environment where operative repair can be instituted promptly. Ideally, this would be a facility with adequate surgical, anesthesia, and ancillary support. When these procedures are performed in a free- standing center, detailed protocols for the rapid transport or admission of patients to an acute- care hospital should be formalized in writing.

D. Patient Care

1. Preprocedure care

a. The physician performing the procedure should have knowledge of the following:

i. Clinically significant history including indications for the procedure.

ii. Clinically significant physical examination including an awareness of clinical or medical conditions that may necessitate specific care.

iii. Possible alternative methods, such as surgery, to obtain the desired diagnostic information or therapeutic result.

b. Informed consent is required.

2. Procedural care

a. Nursing personnel, technologists, and those directly involved in the patient care during Venous Access Procedures should have protocols for use in standardizing care. These should include, but are not limited to, the following:

i. Equipment needed for the procedure.

ii. Patient monitoring.

Protocols should be reviewed and updated periodically.

3. Postprocedure care

a. Orders for postprocedure patient care should include frequency of monitoring of vital signs, central venous catheter care (flushing and dressing change), discharge instructions, etc.

b. Specific anatomic considerations

Postprocedure imaging and follow-up may involve injection of contrast material to confirm catheter placement within the appropriate venous structure.

c. Clinical and imaging follow-up as required.

d. Periodic imaging follow-up may be appropriate if catheter malfunction is experienced.

E. Specifics of the Procedure

1. All invasive image-guided percutaneous procedures involving Central Venous Access are performed for specific indications, and the examination/procedure should therefore be tailored accordingly.

2. The operator performing Central Venous Access should understand catheter maintenance and postprocedure care.

VI. QUALITY IMPROVEMENT

While practicing physicians should strive to achieve perfect outcomes (e. g., 100% success, 0% complications), in practice all physicians will fall short of this ideal to a variable extent. Thus, indicator thresholds may be used to assess the efficacy of ongoing quality- improvement programs. For the purposes of these guidelines, a threshold is a specific level of an indicator that should prompt a review. "Procedure thresholds" or "overall thresholds" refer to a group of indicators for a procedure (e. g., major complications). Individual complications may also be associated with complication- specific thresholds. When measures such as indications or success rates fall below a (minimum) threshold or when complication rates exceed a (maximum) threshold, a review should be performed to determine causes and to implement changes, if necessary. For example, if the incidence of sepsis is one measure of the quality of abscess drainage, then values in excess of the defined threshold (in this case 4%) should trigger a review of policies and procedures within the department to determine the causes and to implement changes to lower the incidence of the complication. Thresholds may vary from those listed here; for example, patient referral patterns and selection factors may dictate a different threshold value for a particular indicator at a particular institution. Thus, setting universal thresholds is very difficult and each department is urged to alter the thresholds as needed to higher or lower values to meet its own quality- improvement program needs.

A. Success Rates and Thresholds

Procedure	Success Rate %	Threshold Level %
Internal Jugular Vein Approach	96	95
Subclavian Vein Approach	95	90
Infusion Port	95	90
PICC	96	90
Peripheral Port	96	90
Translumbar	96	90

Note.-Success rates and thresholds listed are for the adult population and could be expected to be lower in a pediatric population.

B. Complication Rates/Thresholds

Specific Major Complications Suggested for Image-guided Central Venous Access	Rate (%)	Threshold (%)
Subclavian and jugular approaches		
Pneumothorax	1-2	3
Hemothorax	1	2
Hematoma	1	2
Perforation	0.5-1	2
Air embolism	1	2
Wound dehiscence	1	2
Procedure-induced sepsis	1	2
Thrombosis	4	8

Peripheral placement PICC and peripheral ports
Pneumothorax/hemothorax 0 0
Hematoma 1 2
Wound dehiscence 1 2
Phlebitis* 4 8
Arterial injury 0.5 1
Thrombosis 3 6
Procedure-induced sepsis 1 2

Complications are defined as early (within 30 days of procedure) or late (>30 days post procedure). Early complications may be procedurally related i.e. within 24 hours of placement. The incidence of early complications should be lower with image-guided techniques when compared to blind or external landmark techniques. Complications (major and minor) occur in approximately 7% of patients when image guidance is used. Overall procedure threshold for major complications is 3% for subclavian, jugular and peripheral approaches.

VI. REFERENCES

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