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The American College of Radiology will periodically define new practice guidelines and technical standards for radiologic practice to help advance the science of radiology and to improve the quality of service to patients throughout the United States. Existing practice guidelines and technical standards will be reviewed for revision or renewal, as appropriate, on their fifth anniversary or sooner, if indicated.

Each practice guideline and technical standard, representing a policy statement by the College, has undergone a thorough consensus process in which it has been subjected to extensive review, requiring the approval of the Commission on Quality and Safety as well as the ACR Board of Chancellors, the ACR Council Steering Committee, and the ACR Council. The practice guidelines and technical standards recognize that the safe and effective use of diagnostic and therapeutic radiology requires specific training, skills, and techniques, as described in each document. Reproduction or modification of the published practice guideline and technical standard by those entities not providing these services is not authorized.

Revised 2008 (Resolution 15)*

ACR–SIR PRACTICE GUIDELINE FOR THE PERFORMANCE OF DIAGNOSTIC INFUSION VENOGRAPHY

PREAMBLE

These guidelines are an educational tool designed to assist practitioners in providing appropriate radiologic care for patients. They are not inflexible rules or requirements of practice and are not intended, nor should they be used, to establish a legal standard of care. For these reasons and those set forth below, the American College of Radiology cautions against the use of these guidelines in litigation in which the clinical decisions of a practitioner are called into question.

The ultimate judgment regarding the propriety of any specific procedure or course of action must be made by the physician or medical physicist in light of all the circumstances presented. Thus, an approach that differs from the guidelines, standing alone, does not necessarily imply that the approach was below the standard of care. To the contrary, a conscientious practitioner may responsibly adopt a course of action different from that set forth in the guidelines when, in the reasonable judgment of the practitioner, such course of action is indicated by the condition of the patient, limitations of available resources, or advances in knowledge or technology subsequent to publication of the guidelines. However, a practitioner who employs an approach substantially different from these guidelines is advised to document in the patient record information sufficient to explain the approach taken.

The practice of medicine involves not only the science, but also the art of dealing with the prevention, diagnosis, alleviation, and treatment of disease. The variety and complexity of human conditions make it impossible to always reach the most appropriate diagnosis or to predict with certainty a particular response to treatment.

Therefore, it should be recognized that adherence to these guidelines will not assure an accurate diagnosis or a successful outcome. All that should be expected is that the practitioner will follow a reasonable course of action based on current knowledge, available resources, and the needs of the patient to deliver effective and safe medical care. The sole purpose of these guidelines is to assist practitioners in achieving this objective.

I. INTRODUCTION

This guideline, originally developed and written by the Society of Interventional Radiology (SIR) in collaboration with the American College of Radiology (ACR), was revised by the ACR in collaboration with the SIR.

Diagnostic infusion venography is the radiographic study of an extremity with iodinated contrast injection through peripheral intravenous access, often at the level of the hand or the foot. The term does not imply a specific method or rate of contrast injection. Such a study will often visualize the venous system to the level of the superior or the inferior vena cava. However, the term diagnostic infusion venography does not include central or selective venography through an angiographic catheter.

Diagnostic infusion venography is an established, safe, and accurate method when used as indicated and is considered the diagnostic standard by which the accuracy of other venous imaging modalities should be judged. However, alternative methods of studying the venous system such as duplex ultrasound, computed tomography (CT) venography, and magnetic resonance (MR) venography may be preferable in specific clinical situations. In particular, duplex ultrasound has largely replaced diagnostic infusion venography of the upper or

lower extremity since the sensitivity and specificity of duplex ultrasound above the elbow or knee are adequate for the initiation of treatment for deep venous thrombosis (DVT) [1-15]. The use of diagnostic infusion venography may be preferred, specifically for the diagnosis of below-knee and upper extremity DVT and in patients who have had joint replacement [16-20]. However, it has a small but definite risk of complications [21-33].

Diagnostic infusion venography should be performed only for a valid medical reason (e.g., see section II below) and with the minimum radiation dose necessary to achieve an optimal study. While venography is an invasive test with defined risks, it is a valuable and informative procedure performed routinely in the evaluation of disorders of the venous system. The information obtained by diagnostic infusion venography, combined with other clinical and noninvasive imaging findings, can be used to plan or evaluate results of treatment.

This guideline can be used in institution-wide quality-improvement programs to assess the practice of venography. The most important processes of care are 1) patient selection, preparation, and education; 2) performing and interpreting the procedure; and 3) monitoring the patient. The outcome measures for these processes are indications, success rates, and complication rates. Outcome measures are assigned threshold levels.

II. INDICATIONS AND CONTRAINDICATIONS

Indications for diagnostic infusion venography include, but are not limited to:

1. Diagnosis of DVT in a patient:
 - a. With a nondiagnostic duplex ultrasound examination or for whom a duplex examination is not technically feasible.
 - b. Suspected of having infrapopliteal disease.
 - c. With a symptomatic extremity status after joint replacement.
 - d. With a high clinical suspicion for DVT but with a negative duplex examination.
 - e. When duplex ultrasound is not available.
2. As an adjunct during venous thrombolysis.
3. Evaluation of valvular insufficiency prior to stripping or ligation of superficial varicose veins.
4. Venous mapping prior to or following a surgical or interventional procedure.
5. Evaluation for venous stenosis or venous hypertension.
6. Evaluation for venous malformations.

7. Preoperative evaluation for tumor involvement or encasement.

The threshold for these indications is 95%. When fewer than 95% of procedures are for these indications, the department should review the process of patient selection.

There are no absolute contraindications to diagnostic infusion venography. Relative contraindications include, but are not limited to:

1. Evidence of active cellulitis of the extremity to be imaged.
2. Iodinated contrast allergy.
3. Renal insufficiency in patients who are not on dialysis, particularly those with diabetes or congestive heart failure (CHF).

For the pregnant or potentially pregnant patient, see the [ACR Practice Guideline for Imaging Pregnant or Potentially Pregnant Adolescents and Women with Ionizing Radiation](#).

III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

A. Physician

Diagnostic infusion venography examinations must be performed under the supervision of and interpreted by a physician who has the following qualifications:

1. Certification in Radiology or Diagnostic Radiology by the American Board of Radiology (ABR), the American Osteopathic Board of Radiology, the Royal College of Physicians and Surgeons of Canada, or the Collège des Médecins du Québec.
or
2. Completion of a residency program approved by the Accreditation Council for Graduate Medical Education (ACGME), the Royal College of Physicians and Surgeons of Canada (RCPSC), the Collège des Médecins du Québec, or the American Osteopathic Association (AOA) to include a minimum of 3 months training in fluoroscopy and performance of at least 10 extremity venograms.
or
2. In the absence of appropriate ACGME approved residency training as outlined in section III.A.2 above or postgraduate training that included comparable instruction and experience in diagnostic venography, the physician must have experience and demonstrated competency as primary operator in diagnostic venography under

the supervision of an on-site qualified physician, during which a minimum of 10 extremity venograms were performed with documented success and complication rates that meet the threshold criteria in section VIII.

and

3. Physicians meeting any of the qualifications in 1, 2, and 3 above must also have written substantiation that they are familiar with all of the following:
 - a. Indications and contraindications for the procedure.
 - b. Preprocedural assessment, monitoring, and management of the patient and complications.
 - c. Fluoroscopic and radiographic equipment and other electronic imaging systems.
 - d. Principles of radiation protection, the hazards of radiation exposure to both patients and radiologic personnel, and monitoring requirements.
 - e. Pharmacology of contrast agents and recognition and treatment of adverse reactions to them.
 - f. Technical aspects of performing the procedure, including appropriate injection rates and volumes of contrast media, and filming sequences.
 - g. Anatomy, physiology, and pathophysiology of peripheral venous vasculature.
 - h. Interpretation of diagnostic venography.
 - i. Postprocedural patient management, especially recognition and initial management of complications.

The written substantiation should come from the chief of interventional radiology, director or chief of body imaging or ultrasound, or the chair of the department of the institution in which the physician will be providing these services. Substantiation could also come from a prior institution in which the physician provided the services, but only at the discretion of the current interventional director or chair to solicit the additional input.

Maintenance of Competence

Physicians must perform a sufficient number of venographic procedures to maintain their skills, with acceptable success and complication rates as laid out in this guideline. Continued competence should depend on participation in a quality improvement program that monitors these rates.

Continuing Medical Education

The physician's continuing education should be in accordance with the [ACR Practice Guideline for Continuing Medical Education \(CME\)](#).

B. Qualified Medical Physicist

A Qualified Medical Physicist is an individual who is competent to practice independently in one or more of the subfields in medical physics. The American College of Radiology considers certification and continuing education and experience in the appropriate subfield(s) to demonstrate that an individual is competent to practice in one or more of the subfields in medical physics and to be a Qualified Medical Physicist. The ACR recommends that the individual be certified in the appropriate subfield(s) by the American Board of Radiology (ABR), the Canadian College of Physics in Medicine, or for MRI, by the American Board of Medical Physics (ABMP) in magnetic resonance imaging physics.

The appropriate subfields of medical physics for this guideline are Radiological Physics and Diagnostic Radiological Physics.

A Qualified Medical Physicist should meet the [ACR Practice Guideline for Continuing Medical Education \(CME\)](#). (ACR Resolution 17, 1996 – revised in 2008, Resolution 7)

C. Registered Radiologist Assistant

A registered radiologist assistant is an advanced level radiographer who is certified and registered as a radiologist assistant by the American Registry of Radiologic Technologists (ARRT) after having successfully completed an advanced academic program encompassing an ACR/ASRT (American Society of Radiologic Technologists) radiologist assistant curriculum and a radiologist-directed clinical preceptorship. Under radiologist supervision, the radiologist assistant may perform patient assessment, patient management and selected examinations as delineated in the Joint Policy Statement of the ACR and the ASRT titled "Radiologist Assistant: Roles and Responsibilities" [34] and as allowed by state law. The radiologist assistant transmits to the supervising radiologists those observations that have a bearing on diagnosis. Performance of diagnostic interpretations remains outside the scope of practice of the radiologist assistant. (ACR Resolution 34, adopted in 2006)

D. Radiologic Technologist

1. The technologist, together with the physician and nursing personnel, should have responsibility for

patient comfort and safety. The technologist should be able to prepare and position¹ the patient for the venographic procedure. The technologist should obtain the imaging data in a manner prescribed by the supervising physician. The technologist should also perform the regular quality control testing of the equipment under supervision of the physicist.

2. The technologist should be certified by the American Registry of Radiologic Technologists (ARRT) or have an unrestricted state license with documented training and experience in diagnostic venography procedures.

E. Other Ancillary Personnel

Other ancillary personnel who are qualified and duly licensed or certified under applicable state law may, under supervision by a radiologist or other qualified physician, perform specific interventional fluoroscopic or other image-guided procedures. Supervision by a radiologist or other qualified physician must be direct or personal, and must comply with local, state, and federal regulations. Individuals should be credentialed for specific fluoroscopic and other image-guided interventional procedures and should have received formal training in radiation management and/or application of other imaging modalities as appropriate.

F. Nursing Services

Nursing services, when deemed appropriate by the performing physician, are an integral part of the team for preprocedural, intra-procedural, and postprocedural patient management and education and are recommended in monitoring the patient during the procedure.

G. Other Licensed Independent Practitioner

In cases where moderate sedation is used or the patient is critically ill, there should be an experienced licensed

¹The American College of Radiology approves of the practice of certified and/or licensed radiologic technologists performing fluoroscopy in a facility or department as a positioning or localizing procedure only, and then only if monitored by a supervising physician who is personally and immediately available*. There must be a written policy or process for the positioning or localizing procedure that is approved by the medical director of the facility or department/service and that includes written authority or policies and processes for designating radiologic technologists who may perform such procedures. (ACR Resolution 26, 1987 – revised in 2007, Resolution 12m)

*For the purposes of this guideline, “personally and immediately available” is defined in manner of the “personal supervision” provision of CMS—a physician must be in attendance in the room during the performance of the procedure. Program Memorandum Carriers, DHHS, HCFA, Transmittal B-01-28, April 19, 2001.

provider, whose sole responsibility is monitoring of the patient’s vital signs, sedation state, and level of comfort/pain. For moderate sedation, refer to the [ACR–SIR Practice Guideline for Sedation/Analgesia](#).

IV. SPECIFICATIONS OF THE EXAMINATION

There are several technical requirements to ensure safe and successful diagnostic infusion venograms. These include adequate radiographic imaging equipment, institutional facilities, and physiologic monitoring equipment.

A. Venography Equipment and Facilities

The following are considered the minimal equipment requirements for performing diagnostic infusion venography. In planning facilities for diagnostic infusion venography, equipment and facilities more advanced than those listed below may be desired to produce higher-quality studies with reduced risk and time of study. In general, the facility should include at a minimum:

1. A radiography suite that is large enough to allow easy transfer of the patient from the bed to the table and to accommodate the procedure table, monitoring equipment, and other hardware such as intravenous pumps, respirators, anesthesia equipment, and oxygen tanks. Ideally, there should be adequate space for circulation of technical staff in the room without interfering with the contrast injection.
2. For lower extremity venography, a tilt table fluoroscopy unit is desirable.

B. Resuscitation Equipment

There should be ready access to emergency resuscitation equipment and drugs including the following: an emergency defibrillator, an oxygen supply and appropriate tubing and delivery systems, suction equipment, tubes for endotracheal intubation, laryngoscope, ventilation bag-mask-valve apparatus, and central venous line sets. Drugs for treating cardiopulmonary arrest, contrast reaction, vasovagal reactions, narcotic or benzodiazepine overdose, bradycardia, and ventricular arrhythmias should also be readily available. Resuscitation equipment should be monitored and checked on a routine basis in compliance with institutional policies.

C. Support Personnel

Radiologic technologists properly trained in the use of the diagnostic imaging equipment should assist in performing and imaging the procedure. They should be able to

demonstrate appropriate knowledge of patient positioning, venographic image recording, adjunctive supplies, and the location of resuscitation equipment. Technologists should be trained in basic cardiopulmonary resuscitation and in the function of the resuscitation equipment.

D. Patient Care

The written or electronic request for a venography examination should provide sufficient information to demonstrate the medical necessity of the procedure and allow for its proper performance and interpretation.

Documentation that satisfies medical necessity includes 1) signs and symptoms, 2) relevant history (including known diagnoses, and/or 3) prior imaging). Additional information regarding the specific reason for the procedure or a provisional diagnosis would be helpful and may at times be needed to allow for the proper performance and interpretation of the procedure.

The request for the procedure must be originated by a physician or other appropriately licensed health care provider. The accompanying clinical information should be provided by a physician or other appropriately licensed health care provider familiar with the patient's clinical problem or question and consistent with the state scope of practice requirements. (ACR Resolution 35, adopted in 2006)

The appropriate anatomic region/site and side(s) should be indicated on the initial examination request.

1. Preprocedure care

- a. The physician performing the procedure must have knowledge of the following:
 - Clinically significant history including the indications for the procedure.
 - Clinically significant physical examination, including an awareness of clinical or medical conditions that may necessitate specific care.
 - Possible alternative methods, such as ultrasound, MR, or CT, to obtain the desired diagnostic information or therapeutic result.
- b. Informed consent must be in compliance with all state laws and applicable ACR Practice Guidelines and Technical Standards. See the [ACR–SIR Practice Guideline on Informed Consent for Image-Guided Procedures](#).

2. Procedural care

- a. Adherence to the Joint Commission's Universal Protocol for Preventing Wrong Site, Wrong Procedure, Wrong Person Surgery™ is required for procedures in non-operating room settings including bedside procedures. "Time out" must be conducted in the location where the procedure will be done just before starting the procedure and it must:

- Involve the entire operative team.
- Use active communication.
- Be briefly documented, such as in a checklist, and include at least:
 - Correct patient identity.
 - Correct site.
 - Agreement on the procedure to be done.

The organization should have processes and systems in place for reconciling differences in staff responses during the "time out."

- b. During the use of fluoroscopy, the physician should have knowledge of exposure factors, including kVp, mA, magnification factor, and dose rate, and should consider additional parameters such as collimation, field of view, and last image hold.
- c. Nursing personnel, technologists, and those directly involved in the care of patients undergoing venography should have protocols for use in standardizing care. These should include, but are not limited to, the following:
 - Equipment needed for the procedure.
 - Patient monitoring.

Protocols should be reviewed and updated periodically.

V. DOCUMENTATION

Documentation of a complete venogram procedure will vary according to the indication for the examination, as outlined in section II. At a minimum, for any indication, the operator should document and archive a sufficient number of full contrast images of the anatomic region being studied to answer the clinical question that prompted the examination.

Each operator should have full knowledge of the pathophysiology of venous diseases and should tailor the examination appropriately to provide optimal diagnostic information while attempting to minimize the patient's exposure to iodinated contrast and ionizing radiation.

Reporting should be in accordance with the [ACR–SIR Practice Guideline for the Reporting and Archiving of Interventional Radiology Procedures](#).

VI. RADIATION SAFETY IN IMAGING

Radiologists, medical physicists, radiologic technologists, and all supervising physicians have a responsibility to minimize radiation dose to individual patients, to staff, and to society as a whole, while maintaining the necessary diagnostic image quality. This concept is known as “as low as reasonably achievable (ALARA).”

Facilities, in consultation with the medical physicist, should have in place and should adhere to policies and procedures, in accordance with ALARA, to vary examination protocols to take into account patient body habitus, such as height and/or weight, body mass index or lateral width. The dose reduction devices that are available on imaging equipment should be active; if not, manual techniques should be used to moderate the exposure while maintaining the necessary diagnostic image quality. Periodically, radiation exposures should be measured and patient radiation doses estimated by a medical physicist in accordance with the appropriate ACR Technical Standard. (ACR Resolution 17, adopted in 2006 – revised in 2009, Resolution 11

VII. QUALITY CONTROL AND IMPROVEMENT, SAFETY, INFECTION CONTROL, AND PATIENT EDUCATION

Policies and procedures related to quality, patient education, infection control, and safety should be developed and implemented in accordance with the ACR Policy on Quality Control and Improvement, Safety, Infection Control, and Patient Education appearing under the heading *Position Statement on QC & Improvement, Safety, Infection Control, and Patient Education* on the ACR web page (<http://www.acr.org/guidelines>).

Equipment performance monitoring should be in accordance with the [ACR Technical Standard for Diagnostic Medical Physics Performance Monitoring of Radiological and Fluoroscopic Equipment](#).

These data should be used in conjunction with the thresholds described in section VIII below to assess procedural efficacy and complication rates and to trigger institutional review when these thresholds are exceeded.

VIII. QUALITY IMPROVEMENT

These guidelines are intended to be used in quality improvement (QI) programs to assess diagnostic venography. The most important processes of care are patient selection, and performance of the exam. The major outcome measures for diagnostic venography include

diagnosis of pathology and complication rates. Outcome measures are assigned threshold levels.

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, in addition to QI case reviews customarily conducted after individual procedural failures or complications, outcome measure thresholds should be used to assess diagnostic venography in ongoing QI programs. For the purpose of these guidelines, a threshold is a specific level of an indicator which, when reached or crossed, should prompt a review of departmental policies and procedures. Procedure thresholds or overall thresholds refer to a group of outcome measures for a procedure, e.g., major complications for diagnostic venography. Individual complications may also be associated with complication-specific thresholds, e.g., fever or hemorrhage. When outcome measures such as success rates or indications fall below a minimum threshold, or when complication rates exceed a maximum threshold, a departmental review should be performed to determine causes and to implement changes, if necessary. 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 to higher or lower values to meet its own QI program needs.

Complications can be stratified on the basis of outcome. Major complications may result in admission to a hospital for therapy (for outpatient procedures), an unplanned increase in the level of care, prolonged hospitalization, permanent adverse sequelae, or death. Minor complications result in no sequelae; they may require nominal therapy or a short hospital stay for observation (generally overnight). See Appendix A. The complication rates and thresholds in Table 2 below refer to major complications.

Measures of Success

Technical success – Technical success describes the successful placement of appropriate intravenous (IV) access, the use of the appropriate contrast, the acquisition of acceptable images of diagnostic quality and the communication of the findings to the referring physician.

Success rates – Published rates for individual types of complications are highly dependent on patient selection and are based on series comprising several hundred patients, which is a volume larger than most individual practitioners are likely to treat. Therefore, we recommend that complication-specific thresholds usually should be set higher than the complication-specific reported rates listed in Tables 1 and 2. It is also recognized that a single

complication can cause a rate to cross above a complication-specific threshold when the complication occurs in a small volume of patients, e.g., early in a QI program. In this situation, the overall procedure threshold is more appropriate for use in a QI program.

In Tables 1 and 2, all values are supported by the weight of literature evidence and panel consensus.

Table 1 – Successful Rates for Diagnostic Infusion Venography [3,5,11,28,29,33]

	Reported Rates	Suggested Thresholds
Success Rates	84% to 100%	95%

Table 2 – Major Complications of Diagnostic Infusion Venography [21-33]

	Reported Rates	Suggested Thresholds
Death	<1%	<1%
Bronchospasm	<1%	<1%
Cardiovascular collapse	<1%	<1%
DVT with ionic contrast	2.6% to 10%	<3%
DVT with nonionic contrast	0% to 9%	<3%
Contrast-media-induced nephrotoxicity	0% to 0.15%	<2%
Skin necrosis	0% to .05%	0% to .05%

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Principal Reviewer: Curtis A. Lewis, MD, MBA, JD

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Appendix A

Society of Interventional Radiology Standards of Practice Committee Classification of Complications by Outcome

Minor Complications

- A. No therapy, no consequence.
- B. Nominal therapy, no consequence; includes overnight admission for observation only.

Major Complications

- C. Require therapy, minor hospitalization (<48 hours).
- D. Require major therapy, unplanned increase in level of care, prolonged hospitalization (>48 hours).
- E. Permanent adverse sequelae.
- F. Death.

*Guidelines and standards are published annually with an effective date of October 1 in the year in which amended, revised, or approved by the ACR Council. For guidelines and standards published before 1999, the effective date was January 1 following the year in which the guideline or standard was amended, revised, or approved by the ACR Council.

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