



## **CAR Standards and Guidelines for Myelography**

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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. DEFINITION**

Myelography is an invasive diagnostic test using intrathecal contrast material or air to delineate the spinal cord and nerve roots, assess the size of the spinal canal, confirm or exclude disc disease, tumours, abscess or cysts within the cord or canal and find the source of cerebrospinal fluid leaks. Usually water soluble contrast material is injected into the subarachnoid space through a small needle in the lumbar or cervical region and positioned under fluoroscopic control into the region of interest where spot filming provides a permanent record of the area examined. Myelography can be performed in the cervical, thoracic, and/or lumbar regions in the form of a plain film myelogram, plain film myelogram plus CT myelogram or CT myelogram without the plain film sequences or as a cisternogram.

Myelography is an important diagnostic modality for a wide range of spinal and base of skull disease processes. Myelography has been superseded in many of its applications over the last several years by the development of high-resolution computed tomography (CT) and magnetic resonance imaging (MRI). However there remain specific indications and/or circumstances for myelography. It is a relatively easy way to investigate long segments of the thecal sac, and a straight forward method for problem identification with respect to a specific vertebral segment and superficial landmarks. The technique uses readily available standard radiographic equipment.

### **II. PHYSICIAN QUALIFICATIONS**

That Physicians involved in the performance, supervision and interpretation of myelography should be Diagnostic Radiologists and must 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 foreign Specialist qualifications if the Radiologist so qualified holds an appointment in Radiology with a Canadian University.

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 must meet with pertinent provincial/regional regulations. Continuing professional development must meet with the requirements of the Maintenance of Certification Program of the Royal College of Physicians and Surgeons of Canada.

### **III. THE RADIOGRAPHIC FACILITY FOR MYELOGRAPHY**

The minimum requirements for the facility are high-quality imaging equipment, including an image intensifier, television chain, film or digital recording of the examination, and a tilt table. The ideal equipment should have biplane fluoroscopy and filming or C-arm capable of orthogonal views without moving the patient. The examination should be performed on a tilt table capable of sufficient Trendelenburg positioning to run contrast material into the cervical spine and the table should be capable of bringing a prone patient to near standing.

The tilt table should have appropriate restraint devices to secure the patient during examination. The room should be able to do frontal, oblique, and cross-table lateral hard copy images.

A CT scanner to perform post-myelogram CT must be available for cervical and thoracic studies and should be available for lumbar studies.

Appropriate needles and non-ionic contrast agents approved for intrathecal use must be available. Appropriate facilities and equipment for treatment of vasovagal reactions and/or cardiorespiratory collapse must be available.

The personnel must be able to provide proper patient care and operation of the equipment at all times.

#### **IV. INDICATIONS FOR MYELOGRAPHY**

A. Presurgical assessment of degenerative disc disease, spondylopathy and spinal stenosis (when adequate CT or MRI cannot be done).

B. Assessment of acute myelopathy to confirm suspected cord compression prior to decompression or radiotherapy (when MRI is unavailable).

C. Assessment of chronic myelopathy (when MRI is unavailable).

D. Assessment of nondiscogenic radiculopathy.

E. Location of source of CSF leak or dural tear.

F. Confirmation of nerve root avulsion.

G. Confirmation of arachnoiditis.

H. Confirmation and evaluation of arachnoid cysts. I. Confirmation of dural AV fistula prior to angiography (if necessary).

CT and MRI have replaced myelography as the examination of choice for most of the above indications. Inability to do an MRI examination because of patient size or patient contraindication to the MRI study or extensive orthopedic hardware at area of interest should be the main reasons for myelography in centres where there is adequate availability of MRI.

#### **V. RELATIVE CONTRAINDICATIONS FOR MYELOGRAPHY**

A. Either known significant intracranial process with mass effect or neurological signs in keeping with unilateral intracranial mass. Preprocedure CT head may be needed before proceeding with myelography under this circumstance.

B. Historical or laboratory evidence of coagulopathy. If severe will need correction before myelography.

C. Previous myelography performed within one week. Previous lumbar puncture less than one week before myelography increases the risk of a mixed subdural injection which may hamper interpretation of the examination.

D. Generalized septicemia or infection at puncture site. Risk for meningitis. No elective study in this circumstance.

E. Known adverse reaction to iodinated contrast media. Usually safe within subarachnoid space but prudent in individual cases with significant history to premedicate with steroids or use another diagnostic modality.

F. History of seizures (patient may be premedicated).

G. Grossly bloody spinal tap (may proceed when benefit outweighs risk).

H. Pregnancy.

Consider risk-benefits before proceeding. Use of other modality such as MRI is desirable where there is no ionizing radiation.

## **VI. CHOICE OF CONTRAST MATERIAL**

In considering the use of contrast media for the indications listed above, attention shall be given to the use of only those agents approved for intrathecal administration. There have been severe and fatal reactions from the use of other agents. Attention shall also be given to the dosage and concentration of contrast in the procedure and to the timing of any follow-up procedure using intrathecal contrast.

## **VII. PATIENT CARE**

Pre-Procedure:

A. All requests for myelography should be accompanied by a requisition with the name, address/location and relevant demographics of the patient, the name and location of the referring physician including contact phone number and pager. The clinical history and findings, information on other pertinent imaging studies, laboratory results and suspect diagnosis with specific region of interest in the neural axis should be included on the request. This request should be reviewed before the examination is booked to determine whether the examination is indicated and whether it is the appropriate examination for the investigation of the clinical problem. Specific questions with respect to relevant medications, prior seizures, prior allergic reactions, and clotting ability may be asked of the patient at the time of the study.

B. The use of medications that lower the seizure threshold (phenothiazine derivatives, MAO inhibitors, tricyclic antidepressants, CNS stimulants, etc.) must be considered in a risk-benefit analysis for a given patient as these medications may increase the risk of seizures following myelography. Ideally if these medications are to be discontinued they should be stopped for 5 days prior to and for two days following myelography but some physicians discontinue these medications for 48 hours before and 24 hours after the intrathecal use of contrast agents. Special consideration should be given to this group of patients if they are to have outpatient myelography.

C. Recent plain films of the region of interest should be available before the examination is started.

D. The patient should be well hydrated prior to myelography as this reduces the incidence of post lumbar puncture headaches.

E. Careful informed consent should be obtained with the indications and adverse effects of the examination reviewed with the patient and documented in the patient's medical record. The examination should be explained to the patient as part of the consent process. As myelography is an invasive examination the patient should be made aware of other noninvasive modalities which can also image the spinal cord, nerve roots, theca, spinal canal, vertebral bodies and paraspinal space and should be aware of the reason for the choice of myelography.

Post-Procedure:

A. The patient should be instructed to drink plenty of fluids the day of and following the examination with the intent to remain well hydrated. These fluids should not all be coffee or tea and it is desirable to refrain from alcohol for 24 hours following the examination.

B. If the examination was a small needle study (size 25 gauge) the patient can ambulate immediately and only need to return to the supine position if headache develops. These patients are encouraged to remain head elevated for the day. Bed rest will be needed for varying times after studies with larger lumbar puncture needle holes. Regardless of needle size the patient should be nursed with head slightly elevated (at least one pillow) to slow the migration of the more concentrated contrast into the head early in the recovery period. Any standard analgesic is appropriate for pain relief but the key in

treating post lumbar puncture headaches is hydration and the maintenance of a recumbent position which slows CSF leakage.

C. A preliminary report should be written in the patient's medical record with post procedural orders. The written report should be generated and expeditiously communicated to the referring physician and a copy placed in the patient's medical record.

D. Outpatients should be given a contact number and instructions for follow up care in the event of persistent headache, nonpositional progressive headache or progressive neuralgia or worsening clinical symptoms.

E. Outpatients should not drive themselves the day of the procedure and should be accompanied from the hospital or facility and should remain in the company of a responsible adult overnight.

F. Most patients can return to light work or normal activities the day following the examination.

### **VIII. THE MYELOGRAM EXAMINATION**

The skin is prepared with a suitable antiseptic and sterile technique is used for the procedure. Local anaesthesia may be used but is often unnecessary for small needle midline lumbar punctures. Oblique punctures through paraspinous muscles and cervical punctures will need local anaesthesia.

The smallest possible needle (25 gauge or smaller) should be used for lumbar puncture as this lowers the risk of post lumbar puncture headache. If CSF opening pressure is to be recorded a needle size of 22 gauge is necessary. CSF harvesting may be done with a 25 gauge needle but is much easier if a 22 gauge is chosen. In the lumbar spine the puncture site is chosen away from the level of suspected pathology so inadvertent needle defects (mixed injections) are less likely to mask positive findings. The preferred puncture site level is usually L2-3 or L3-4. A dry thecal tap should be used for contrast injection only when the benefit exceeds the risk or if CSF pressure is known to be low and the needle position looks intrathecal on two views 90° to each other. It is hazardous to the patient to inject into an intrathecal mass or into the spinal cord. Contrast material should be instilled at a rate and position which does not cause patient discomfort.

Using the tilt table contrast is made to flow to dependent regions of interest.

Standard films in the lumbar spine would include AP, both oblique, lateral and at least one view of the conus as a minimum series. The AP film should show the bottom of the thecal sac to be well-filled. Oblique views should be chosen which best demonstrate the nerve roots and sleeves (usually the best view of the pars interarticulars also). Standing views and flexion/extension views can be useful in selected patients.

Thoracic myelography films should include a prone AP series showing the subarachnoid space up to the lower cervical level with lateral and supine films. The lateral film may be done with the patient decubitus symptomatic side down.

The film format and size is less important but the sequence of films should be such that a reviewer not present at the time of the study can determine the site, side and location in the patient of any abnormality shown on the images. If this localization is not possible it behooves the examiner to mark/number pertinent vertebrae as localizers on the films.

Cervical myelography may be done from direct lateral C1-C2 cervical puncture or from a lumbar puncture approach with dependent positioning of CSF into the cervical theca. Cervical myelography films should include AP prone, both oblique, and lateral views as a minimum. Usually a swimmer's view in the lateral plane is necessary for the cervical dorsal junction. If foramen magnum pathology is suspect then at the end of the examination a supine cross table lateral film centered at the foramen magnum is included to show contrast entering the foramen magnum. Because technically good quality cervical myelography is very dependent upon adequate neck extension and significantly more patient cooperation than elsewhere in the neural axis, it is not uncommon to have less than optimal diagnostic images in the cervical spine. CT post myelogram shows cervical disease well. It is mandatory to have CT back up at any center where cervical myelography is being done and most cervical myelograms will have post examination CT scans as a complementary study.

Cisternal studies for CSF leak or clarification of cisternal mass or cyst need much less contrast than standard myelography with 5-10 ccs. usually sufficient. A standard thecal puncture with Trendelenburg positioning with

the neck gently flexed will usually allow enough contrast spillage into the basal cisterns for satisfactory CT scanning. To diagnose CSF leaks the patient must be leaking at the time of examination.

## **IX. THE CAVEATS**

- A. Far lateral disc herniations (up to 10% of all discs) provide clinical false localizing signs and are not diagnosable on myelography. They are easily seen on CT or MRI.
- B. At L5-S the thecal sac may be short with the anterior epidural space very wide and a huge symptomatic central herniation here may not displace the sac and can be easily overlooked. This diagnosis can easily be made with CT or MRI.
- C. Pars defects not readily seen on myelography in the absence of slippage can be readily seen on CT scan.
- D. Subdural or mixed injections, if they are not recognized as such, may mimic the appearances of epidural tumours, spinal block, arachnoiditis or intrathecal carcinomatosis and may cause incorrect subsequent patient management.
- E. CT scanning will show contrast in the canal and around cord at much lower concentrations than can be seen on fluoroscopy or spot films. CT can salvage a myelographic examination of poor diagnostic quality.
- F. CT scanning will often show contrast beyond an apparent block.
- G. Lesions of the foramen magnum and their associations are better assessed at MRI.
- H. Beware of low extrathecal pathology in lumbar spine. Sacral root compressive pathology at S1 is not always a disc though L5-S1 disc herniation is common enough. Myelography does poorly in diagnosing sacral tumours. Combining myelogram with follow-up CT is desirable unless clinical findings/history/films confirm nerve root compression is caused by disc.
- I. An extradural lesion such as a herniated disc or osteophyte may compress the cord causing apparent widening in one view mimicking an intramedullary lesion and leading to a false diagnosis. There should always be at least two orthogonal views of any area of pathology and cord widening should always be viewed in at least two orthogonal planes, preferably antero-posterior and lateral.
- J. Myelography can diagnose an enlarged cord but does not differentiate cord widening due to hemorrhage, abscess, myelitis, tumour or syrinx. MRI can differentiate these and is the examination of choice for these conditions.
- K. With neoplastic lesions or spinal block in patients for surgery it greatly aids the surgeon in planning if the level of the lesion is marked/scratched on the skin indelibly just off the midline away from the plane of surgical incision.
- L. Special precautions need to be taken for assessment of clinically suspected total block where alteration in CSF dynamics and pressure below the lesion may precipitate increasing cord dysfunction and worsening clinical picture after myelography. A cervical puncture may prevent this.
- M. Special caution should be taken during cervical myelograms for investigation of cervical myelopathy due to degenerative disc disease where the position of the patient's neck in hyperextension for the examination can cause worsening myelopathy due to cord compression.

## **X. SURGICAL AND EMERGENCY SUPPORT**

Although serious complications of myelography are infrequent, there should be prompt access to surgical and interventional management of complications.

## **XI. EQUIPMENT AND QUALITY CONTROL**

Examinations should be performed with fluoroscopic and radiographic equipment meeting all applicable federal and provincial radiation standards. Each imaging facility should have documented policies and operations for monitoring and evaluating the effective management, safety and operation of imaging equipment. The quality control program should be designed to minimize patient, personnel and public radiation risks and maximize the quality of diagnostic information. At least annually or as required by provincial law, equipment performance should be monitored and a quantitative dose determination should be conducted by a qualified medical radiation physicist or a qualified designated substitute.

## **XII. RADIOLOGIC TECHNOLOGISTS**

The medical radiation technologist must have Canadian Association of Medical Radiation Technologists 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, and for image technical evaluation and quality and applicable quality assurance. The training of technologists engaged in specialty activities shall meet with applicable and valid national and provincial specialty qualifications. Continued education of technologists is encouraged by the CAMRT and should meet pertinent provincial regulations.

## **XIII. MAINTENANCE OF COMPETENCE**

To maintain privileges, physicians must perform a sufficient number of myelographic procedures to maintain their skills with acceptable success and complication rates.

## **XIV. QUALITY IMPROVEMENT**

Procedures should be monitored as part of the overall quality improvement program of the facility. Incidence of complications and adverse reactions as well as the accuracy of radiologic interpretations should be recorded and periodically reviewed for the opportunity to improve patient care. Data should be collected in a manner which complies with statutory and regulatory peer review procedures in order to protect the confidentiality of the peer review data.

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