Endoscopic Epidural Visualization
Procedural Hints

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Introduction
Interest in viewing the contents of the bony vertebral canal using percutaneously placed devices has existed for a long time. As early as 1931 Burman used arthroscopic equipment to examine the anatomy of vertebral columns removed from cadavers. Significant advancement of epiduroscopy toward clinical application occurred only after introduction of flexible fiberscopes capable of delivering high quality images, especially with computer enhancement, and development of suitable light sources. This equipment has been used to view both the spinal epidural space as well as the spinal subarchnoid space. The use of lumbosacral epiduroscopy for diagnostic and therapeutic purposes in pain management has increased rapidly beginning in the mid 1980’s. At that time, lumbosacral epiduroscopy as an aid to lysis of epidural adhesions began to be explored. The lysis procedure is based on evidence that adhesions in the epidural space are involved in the pathophysiology of low back pain and/or radiculopathy and prevent delivery of therapeutic agents to target sites.

The procedure involves:
1) Definition of a filling defect on epidurography that corresponds to the spinal segment innervating the painful area
2) Insertion of a catheter into the defect and injection of normal saline and hyaluronidase to remove tissue (fibrosis) barriers to contrast flow, and
3) Injection of therapeutic agents through the catheter to the target site.
It was reasoned that a flexible endoscopic device with a deflectable tip and a working channel would facilitate catheter placement, provide mechanical in addition to hydraulic forces to break tissue barriers and provide visual information that would aid in diagnosis and prognosis. Substantial clinical experience and published data demonstrated the safety and efficacy of epiduroscopy.

Indications
General indications for epiduroscopy (spinal canal epiduroscopy) presented in a consensus paper by an international group of experts are:
- Observation of pathology and anatomy
- Direct drug application
- Direct lysis of scarring (with medication, blunt dissection, laser and other instruments)
- Placement of catheter and electrode systems (epidural, subarachnoid)
- An adjunct to minimally invasive surgery

The most common indications for epiduroscopy are to examine the lumbosacral epidural space of patients with chronic radicular symptoms and/or low back pain to identify pathology and to administer therapy to the area(s) where there is pathology.

Contraindications
Epiduroscopy should not be performed on patients for whom other diagnostic approaches are definitive and for whom other therapy, such as surgery, is clearly indicated.

Other contraindications include:
- Systemic infection or local infection at the epidural access site
- Uncontrolled drug abuse or dependency
- Uncontrolled major depression or psychiatric disorders
- Uncontrolled or acute medical illnesses
- Bleeding dysesthesia or abnormal laboratory values reflective of impaired blood clotting capability
- Pregnancy or lactation
- Cerebrovascular disease or space occupying lesions in the central nervous system
Principles of Technique

The epiduroscope allows for three-dimensional direct visual observation. During epiduroscopy, equipment is used that displays on a monitor both the epiduroscopic image and the fluoroscopic image (Twinvideo). Which is the primary image and which is the secondary image can be changed. Usually the epiduroscopy image is the primary one except when more detail from the fluoroscopy image is needed than can be obtained with it as a smaller secondary image. The examination of the epidural space may extend from the sacrum to as far cephalad as the posterior border of L2, depending upon the patient’s area of symptoms and the extent of abnormalities encountered. Skill is required to manipulate the epiduroscope through the bony vertebral canal and to direct the scope tip to areas of interest.

Procedure

The epiduroscope is inserted via a sheath placed through the sacral hiatus. Fluoroscopy is used to verify proper placement. During the epiduroscopy procedure, preservative free 0.9% saline is injected through the working channel of the epiduroscope to expand the epidural space and to flush away tissue debris and any extravaslated blood to provide optimal viewing.

How successful this is depends upon many factors, including how fast fluid is infused, compliance of the contents of the space, presence of compartments and how fast fluid exits through the intervertebral foramen into the paraspinal area.

Care must be taken to use the minimal amount of saline. The total volume infused should generally not exceed 100 ml. In addition to monitoring the volume infused, epiduroscopy time should be monitored. At the Texas Tech University Health Science Center, epiduroscopy time usually is less than 30 minutes.

If the patient has unilateral symptoms, first the epidural space is examined contralateral to the symptomatic side. This provides the general appearance of the “normal” epidural space for the patient. Next, the symptomatic side is examined with emphasis on viewing the area where the nerve or nerves that innervate the symptomatic side transverse the epidural space and pass through the intervertebral foramen. The presence or absence and the character of the following tissue can be noted – fat, blood vessels and fibrous tissue as well as the presence of abnormal tissue and of inflammation.

The scope tip readily exits a normal intervertebral foramen. The goal is to find an area or areas of pathology that when touched by the tip of the epiduroscope, produces arousal and/or pain in the painful area ascertained during the pre procedure evaluation.

Abnormalities seen include discrete or diffuse inflammation, diffuse or discrete fibrosis that ranges from mild (through which the scope easily passes) to a dense, solid mass through which the scope cannot be passed (Pic. A-F). Increased vascularity (small and/or larger vessels) and/or engorged, distended blood vessels may be seen. Fibrous scars may be avascular or have varying degrees of vascularity.

After the diagnostic phase of the procedure, the treatment proceeds, including to break any existing fibrosis that was not lysed during the examination. The lysis is accomplished by using mechanical force delivered by moving the tip of the epiduroscope and by injecting hyaluronidase and normal saline through the working channel of the scope. Radiopaque contrast material is injected through the working channel to determine if there is a path for fluid to flow into the area of pathology associated with the patient’s symptoms. Then local anaesthetic and corticosteroid are injected through the scope’s working channel to the target site. More than one area may be treated depending upon clinical presentation of symptoms and epiduroscopy findings. After the treatment is finished, the epiduroscope and the sheath are removed. The site is covered with antibiotic ointment and occlusive dressing. The patient is observed until criteria for discharge from the hospital are met.
Endoscopic Epidural Visualization

A: L5 Right side: Normal looking fat

B: L4 Left side: Engorged blood vessels

C: L4-5 Midline: Grade 2 fibrosis with increased vascularity

D: L5 Left side: Grade 3 fibrosis

E: L5 Right side: Active inflammation with increased vascularity

F: L5 Left side: Dense laminotomy scar
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Difficult technical aspects:
A – Placing the dilator and sheath
A sheath which provides access to the epidural space is placed through the sacral hiatus using the Seldinger technique. First an epidural needle is inserted through the sacral hiatus and then a guide wire is passed through the needle. A stab wound is made directly beside the needle and parallel to it through the sacrococcygeal ligament. Next, the needle is removed and a dilator passed over the guide wire through the hiatus. The dilator is removed, inserted into the sheath and together passed through the tract made by the sheath alone. After this is done, the dilator and guide wire are removed, leaving the sheath in place.

B – Advancing the epiduroscope to the area(s) of interest
AP and lateral fluoroscopic viewing should be used as needed to assure that the dilator and sheath follow the guidewire and are directed as straight as possible toward the sacral hiatus. The dilator and sheath must be advanced as a unit and there must not be tissue between the stab wound and the path of the dilator and sheath. Usually a 10F dilator and sheath is used but if difficulties are encountered a 9F dilator will be used and then switched to a 10 F or continued with a 9F sheath. Access usually is much easier in females than in males. It rarely fails with females but fails in about 1 out of 15 males.

Before inserting the epiduroscope, be sure it is in focus and colour balanced. Establish a neutral or reference position for the scope to aid orientation and to establish up/down, right/left for scope tip manipulation as well as for image interpretation. When advancing the scope, rotate it and deflect the tip so the scope follows the spinal canal. Identification of the correct spinal level is almost impossible without simultaneous fluoroscopy. Fluoroscopy is used in the pulse mode. Total fluoroscopy time for a procedure is usually less than one minute.

Avoid introducing air into the injected fluid. This causes distortion of the epiduroscopic image and can be difficult to move out of the visual field.

Recognition of structures and pathology is challenging. It is absolutely essential to be familiar with the anatomy of the epidural space and other contents of the spinal canal, especially as viewed through an epiduroscope. Also essential is familiarity with the type and appearance of pathology that might be encountered.

Efficacy
by Prof. James E. Heavner, D.V.M., Ph.D.

In a systematic review of spinal endoscopy, Chopra et al, retrieved 112 articles using their search criteria, and 8 of the articles were considered to be relevant reports of studies of spinal endoscopic adhesiolysis. Two randomised, double-blind evaluations, 3 prospective evaluations, and 3 retrospective evaluations and multiple case reports were available for review.

The randomised trials showed significant improvement in pain relief, as well as multiple other parameters including return to work at 3 months, 6 months, and 1 year. The prospective evaluations also showed improvement. Two retrospective evaluations included in the analysis showed positive short-term and long-term results.

Complications
by Prof. James E. Heavner, D.V.M., Ph.D.

In the experience to date, no complications unique to epiduroscopy have been reported in the literature. Complications generally associated with accessing the epidural space, inserting needles and catheters, and injecting fluids have been reported or may occur.

These are: Infections, epidural hematoma, bowel or bladder dysfunction, headache, visual disturbances secondary to retinal haemorrhage, dysesthesia and residual pain at the injection site. Entry into the subarachnoid or subdural space may occur. If not recognised, this may lead to complications resulting from injection of drugs or fluid volumes appropriate only for epidural administration.
Instruments

11161 EK

**Epiduroscope**, steerable
Working channel: 1.2 mm
Direction of view: 0°
Angle of view: 90°
Working length: 40 cm
Diameter: 2.8 mm
Deflection: 170°/120°

**Accessories included:**
- 27677 BN  **Instrument Case**
- 11025 E  **Pressure Compensation Cap**, for ventilation during gas sterilisation
- 13242 XL  **Leakage Tester**, with bulb and manometer
- 11161 KB  **Grasping Forceps**, double action jaws, flexible, diameter 1 mm, working length 60 cm
- 11161 KA  **Biopsy Forceps**, double action jaws, flexible, diameter 1 mm, working length 60 cm
- 27651 AL  **Cleaning Brush**, for working channel, diameter 1 mm, working length 75 cm

11161 E

**Epiduroscope**, steerable
Working channel: 1.2 mm
Direction of view: 0°
Angle of view: 90°
Working length: 70 cm
Diameter: 2.8 mm
Deflection: 170°/120°

**Accessories included:**
- 27677 BN  **Instrument Case**
- 11025 E  **Pressure Compensation Cap**, for ventilation during gas sterilisation
- 13242 XL  **Leakage Tester**, with bulb and manometer
- 11161 MB  **Grasping Forceps**, double action jaws, flexible, diameter 1 mm, working length 100 cm
- 11161 MA  **Biopsy Forceps**, double action jaws, flexible, diameter 1 mm, working length 100 cm
- 27651 AL  **Cleaning Brush**, for working channel, diameter 1 mm, working length 150 cm
9045 S  SCHÜTZE Insertion Set, 9 Fr., single use, sterile
consisting of:
puncture needle, guide wire (SELDINGER method), separate hemostasis
valve as port for epiduroscopy – with irrigation option, package of 25

11161 KA  Biopsy Forceps, double action jaws, flexible,
diameter 1 mm, working length 60 cm
11161 MA  Same, working length 100 cm

11161 KB  Grasping Forceps, double action jaws, flexible, dia-
    meter 1 mm, working length 60 cm
11161 MB  Same, working length 100 cm