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ORIGINAL RESEARCH

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BACKGROUND AND PURPOSE: Diskography is commonly performed to investigate pain of suspected diskogenic origin. Although uncommon, diskitis is a feared complication of this procedure. We reviewed the incidence of diskitis and other infectious complications following diskography in a large busy outpatient practice and discuss technical aspects that may contribute to infection prevention.

METHODS: We reviewed the electronic records of all diskograms obtained at our institution during a 12.25-year period, looking for all cases of procedure-related infection. All diskograms had been obtained by skilled and experienced procedural radiologists in dedicated spine-injection suites with specialized technical staff.

RESULTS: There were 12,634 examinations performed on 10,663 patients for a total of 37,135 disk levels. Of the disk levels, 5981 were cervical; 3083, thoracic; and 28,071, lumbar. Two cases of confirmed lumbar diskitis and no cases of either cervical or thoracic diskitis were seen in our series. No other infectious complications were found. The incidence of diskitis was 0.016% per examination and 0.0054% per disk level.

CONCLUSION: In skilled and experienced hands using proper technique, diskography is a safe outpatient procedure with an extremely low incidence of diskitis and other procedure-related infections.

Since its introduction by Lindblom in the 1940s,[1] diskography has evolved into a valuable tool in assessing patients with pain of suspected diskogenic origin. Reported complications of diskography are uncommon and include spinal headache, intrathecal hemorrhage, arachnoiditis, inadvertent subdural injection, diskitis, epidural abscess, subdural empyema, retropharyngeal abscess, sudden quadriplegia, and nucleus pulposus pulmonary embolism.[2-8] The most commonly encountered feared complication, diskitis, is reported to range in frequency from 0% to 4.92% of patients and 0% to 3% of disks injected, with an overall occurrence of <0.25% of patients and 0.14% of disks.[2]

In this report, we review the cases of cervical, thoracic, and lumbar diskography performed on more than 10,000 patients at our institution during a 12-year period, looking specifically at infectious complications. Technical considerations in relation to diskography are reviewed.

Methods

Records of all diskograms obtained at our outpatient imaging centers in the Minneapolis/St. Paul metropolitan area following institution of electronic record keeping in August 1993 through October 2005 were collected and reviewed. Cases from affiliated centers outside of the Twin Cities were excluded from this series.[9] The breakdown of diskography cases is summarized in Table 1. Procedures were performed by 6 experienced procedural radiologists using a technique previously reported.[10] Specifically, the examinations were performed in a dedicated procedural suite using a sterile technique and high-resolution C-arm fluoroscopic guidance. Conscious sedation was only rarely performed in this series.

Initially, the patient's skin was marked with the back of a ballpoint pen after fluoroscopic localization of the route for optimal needle placement. The patient's skin was then thoroughly scrubbed with an iodine solution (or iodine-free solution if allergic), which was allowed to stay on the skin for at least 2 minutes. The skin was finally rinsed with either 99% isopropyl alcohol or ethanol before placement of sterile drapes. The skin was repeatedly rinsed with alcohol before each needle puncture. Iodinated contrast (iohexol, 240 mg/mL; Omnipaque GE Healthcare, Piscataway, NJ) was used in all but a few isolated cases. Either sterile saline without preservative or gadolinium (Omniscan) contrast mixed with sterile saline was used in cases of iodine allergy. From November 1996 onwards, cefazolin 100 mg/mL was admixed with the contrast or saline injectant in a 4–5:1 ratio of contrast to antibiotic. Patients with cephalosporin or penicillin allergy received no antibiotics until 2004, at which time gentamycin 10 mg/mL was substituted. Intravenous antibiotics have not been used in our practice.

Table 1: Breakdown of diskography in 11,599 exams on 10,229 patients

Anatomic Level	No. of Exams by Level	No. of Disks Examined by Level	No. of Unsuccessful Exams*
Cervical	2085	5981	53
Thoracic	1141	3083	17
Lumbar	9408	28 071	63
Total	12 634	37 135	133

* Number of exams in which 1 or more diskography levels were unsuccessful or not attempted.

Single-needle technique was performed by using a 22 ga Spinal needle for lumbar, a 22 or 25 ga needle for thoracic, and a 25 ga for cervical diskography. Concordant intensely painful disks (≥7/10 visual analog scale) were injected with up to 2 mL of lidocaine 4% for pain control and to prevent referred pain to subsequently studied disk levels. As requested by the referring physician, a minority of patients with concordantly painful disks also received intradiskal steroids, typically methylprednisolone acetate (Depo-Medrol), not to exceed 80-mg total dose, or 12 mg of betamethasone sodium phosphate/acetate (Celestone Soluspan) mixed with lidocaine 2%–4%. Following diskography at each level, the needle was immediately removed before study of the next disk.

Patients were discharged with verbal and written instructions to

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Table 2: Incidence of diskitis

Level	No. of Cases of Diskitis	% Incidence per Exam	% Incidence per Disk
Cervical	0	0	0
Thoracic	0	0	0
Lumbar	2	0.021	0.0071
Total	2	0.016	0.0054

report any potential complications including progressive worsening of pain, especially if new and/or different from their typical symptoms; fever; and new neurologic symptoms such as weakness, numbness, or difficulty with bowel or bladder function or ambulation. From 1993 to 1997, patients were routinely contacted by telephone 5 days following the procedure to assess persistent pain or complications. This contact was terminated at the time intradiskal antibiotics were added. In addition, patients were followed up by their referring spine physician within days or weeks after the procedure.

Results

A total of 12,634 examinations were performed on 10,663 patients for a total of 37,195 disk levels (Table 1). In 133 examinations, 1 or more disks were either not attempted or not successfully punctured, usually because of anatomic considerations. Of the total, 11,535 were considered purely diagnostic examinations; 1099 were also considered therapeutic, in that intradiskal steroid was administered into concordant intensely painful disks. The therapeutic injections were performed either immediately following the diagnostic injection or as an entirely separate procedure on a subsequent visit.

Two patients developed lumbar diskitis during this period (Table 2). This corresponds to an overall incidence of 0.016% per examination and 0.0054% per disk level studied. There were no cases of cervical or thoracic diskitis and no cases of epidural or retropharyngeal infection. One patient who developed diskitis was an otherwise healthy 17-year-old girl who underwent a 3-level lumbar diskography at L3–4 through L5-S1. Antibiotic was not used during the diskography because of a question of allergy. The 2 lower levels were concordantly painful and treated with intradiskal steroid without complication. It was the healthy control L3–4 disk level that developed *Staphylococcus* diskitis.

The second and more recent patient was a 22-year-old otherwise healthy woman who underwent a 3-level lumbar diskography at L3–4 through L5-S1 to investigate chronic severe back, buttock, and pelvic pain. Gentamycin was used instead of cefazolin because of allergy to both penicillins and cephalosporins. The patient presented clinically 6-weeks postprocedure with worsening back pain, somewhat different from her chronic pain. Laboratory tests revealed mild leukocytosis with an erythrocyte sedimentation rate (ESR) of 56. A gadolinium-enhanced MR imaging lumbar study revealed enhancement of the vertebral body endplates and subjacent bone marrow at L4–5, which had been at a painless control level when studied. Disk biopsy failed to grow any organisms. The patient was empirically treated with intravenous (IV) antibiotics on the basis of a presumptive diagnosis of diskitis, and pronounced clinical improvement was evident within days of the institution of treatment.

Discussion

The literature for diskitis following lumbar diskography from 1967 to 1991 has been summarized, with rates for diskitis ranging from 0% to 3% of disks injected.[2] The number of disks studied in these reports range from 134 to 6042. In the largest series, Guyer et al[11] reported 3 cases of diskitis in 2014 patients and 6042 disks for an incidence per disk of 0.05%. More recently, Willems et al[12] combined their lumbar diskography experience with 9 studies from 1962 through 2003 and reported an overall incidence of 0.091% infection by disk for a combined total of 13,205 disk levels in 5091 patients. These studies had in common the lack of prophylactic antibiotic use. The authors concluded that the routine use of prophylactic antibiotics for lumbar diskography performed with a styleted 2-needle technique was not indicated. In several large series of cervical diskography, the incidence of infection (diskitis and retropharyngeal abscess) ranged from 0.13% to 0.74% of injected disks.[6,7,13,14]

The technique of lumbar diskography has changed since its introduction in the 1940s, evolving from a typically midline transdural approach to a lateral decubitus approach and to the prone posterolateral approach commonly used today.[15] Procedures are performed in most institutions today by using high-resolution C-arm fluoroscopy. Our technique for cervical, thoracic, and lumbar diskography has been reported previously.[10,16,17] Salient features of this technique, which may account for the low rate of diskitis, include the experience of the operators, the use of a rapid single-needle-per-level technique, and the liberal use of alcohol on the skin and gloves during the procedure.

The authors do not formally scrub, gown, and mask for spine injection procedures. All of the proceduralists (currently 6 total) perform a large volume of spinal injection procedures full-time and have specific training and experience in all other aspects of spine imaging. Several authors have stressed the double-needle or coaxial technique for reducing diskitis.[2,11,12,18] Our experience suggests otherwise, because we use styleted single spinal needles ranging from 3.5 to 7 inches in length. The ease of the single-needle technique reduces procedural time, typically 2–5 minutes from skin puncture to needle removal from each disk studied. Careful procedural planning and experience have largely eliminated the need for multiple concurrently placed needles. On rare occasions, a needle will be left in place for possible subsequent reinjection, while a neighboring disk is injected. In this situation, the needle will be draped with alcohol-soaked gauze until it is needed. The use of antibiotics admixed with contrast has not been clinically proved to prevent diskitis; however, experimental evidence combined with the low morbidity of antibiotics in nonallergic individuals suggests that their use is justified.[19] Although there are experimental models supporting the role of IV antibiotics,[20,21] there is a paucity of clinical support for this approach.[12]

We recorded 3 confirmed diskitis cases in our practice in 1987–1991, when our 2 diskographers were less experienced, using conventional nonmobile fluoroscopy equipment and experimenting with various procedural techniques. We were not using intradiskal antibiotics during this period, and needles were left in each disk until the entire procedure was completed, because filming was cumbersome without a C-arm. In

2 of these cases, *Staphylococcus aureus* infection was confirmed in patients presenting with severe pain and prostration within 36 hours of diskography. Both were treated successfully with IV antibiotics and progressed to nonsurgical fusion of the infected segment. The third disk infection was subclinical and detected purely because of an elevated ESR 3 months after diskography, drawn as part of a preoperative laboratory screen. MR imaging, thereafter, revealed typical findings of lumbar diskitis without abscess formation. No organism was ever retrieved or cultured. The patient was empirically treated with IV antibiotics and ultimately autofused the infected segment during subsequent months. These early cases are excluded from our current series because of the major change in record keeping that we instituted in 1993, as well as significant change in technique, including the routine use of a single needle (rapid in and out) for each disk and C-arm fluoroscopy. We were not able to retrieve accurate data regarding the number of cases performed and disk levels studied from the time before the 1993 system upgrade.

The pathophysiology of diskography-induced diskitis has been firmly established.[22] As few as a single bacterial organism can cause diskitis in experimental sheep.[18] Skin contaminants such as *Staphylococcus epidermidis* or *S aureus* are common, and mixed flora have been cultured from a retropharyngeal abscess, presumably from violation of the oropharynx.[14] Predisposing factors for infection include diabetes, granulocytopenia, male gender, a short, stocky neck, and the presence of a beard.[6] Patients with diskitis typically present with increased back or neck pain and elevated ESR. A high index of suspicion must be maintained in these patients because diagnosis is frequently delayed. In addition, the incidence may be underreported because of lack of clinical contact between the radiologist and patient, lack of awareness by the clinician, and the latency period between the procedure and symptoms.[3] The typical natural history of diskitis is that of a self-limited course that abates in 8–11 weeks in the lumbar spine and proceeds to spontaneous fusion in the cervical spine in 6–7 weeks.[11]

The authors acknowledge limitations of this retrospective study. The possibility of patients' developing diskitis who may not have come to clinical attention is illustrated by our pre-1993 case of lumbar diskitis discovered on a routine preoperative ESR. The true incidence of subclinical diskitis in this series is unknown. Additionally, there may have been patients lost to follow-up or who obtained follow-up outside of our referral base. Because we did not routinely contact all patients after diskography, it is possible that cases of diskitis may have been missed. From 1993 to 1997, we contacted or attempted to contact all patients after diskography 5 days following the procedure; however, this proved to be a low-yield time-consuming endeavor and was terminated at the time routine intradiskal antibiotics were initiated. No cases of diskitis were uncovered as a result of these routine telephone calls. As a result, the data may underestimate the true incidence of diskitis in this series of patients.

Conclusions

Diskography is a safe procedure, which has a very low complication rate in the hands of skilled and experienced proceduralists. The use of a rapid single-needle technique, copious cleansing of the skin with alcohol, and possibly the use of intradiskal antibiotics have resulted in an extremely low rate of diskitis or other diskography-related infections at our institution.

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