THE POTENTIAL CAUSATIVE FACTORS IN DISCITIS AFTER LUMBAR MACRODISCECTOMY

Serdar Özgen, M.D. / Deniz Konya, M.D.
Selçuk Peker, M.D. / M. Necmettin Pamir, M.D.

Department of Neurosurgery, Faculty of Medicine, Marmara University, Istanbul, Turkey.

ABSTRACT

Objective: Development of discitis after lumbar discectomy is one of the most important complications of disc surgery. This retrospective study investigated the influence of potential contributing factors in 9 cases of postoperative discitis occurring in 2901 patients who underwent macrodiscectomy.

Methods: The specific factors considered were age, sex, history of diabetes mellitus, level of the herniated disc, number of levels operated, occurrence of dural tear and cerebrospinal fluid fistula during surgery, postoperative superficial wound infection, and antibiotic regime. Concerning the latter, Group 1 (n=471) received triple-drug multi-dose antibiotic prophylaxis, and Group 2 (n=2430) received single-drug single-dose antibiotic prophylaxis.

Results: The overall incidence of postoperative discitis in the series was 0.31%. Five of the discitis patients were in Group 1 and four were in Group 2, thus the group rates of postoperative discitis were 1.06% and 0.16%, respectively. The frequencies of discitis according to level of disc herniation were 0.91% for L3-L4, 0.36% for L4-L5, and 0.33% for L5-S1. There was no correlation between postoperative discitis and post-surgery superficial wound infection.

Conclusion: The study showed that administering a single prophylactic dose of one antibiotic prior to surgery reduces the risk of postoperative lumbar discitis and superficial wound infection. Of the factors investigated, antibiotic regimen was the only one that was significantly associated with postoperative discitis.

Key Words: Lumbar disc herniation, discectomy, discitis

INTRODUCTION

Lumbar disc surgery is one of the most common types of neurosurgery performed today (1,2). This procedure was first described by Mixter and Barr in 1934, and has since been performed using a variety of open (macrodiscectomy, microdiscectomy) and closed (chemonucleosis, percutaneous discectomy, endoscopic discectomy) techniques (2-7). Regardless of the method used, infection in the intervertebral disc space is a serious complication of disc operations, and this occurs in 0.2% to 2% of cases (3,4,8-16). Some of the identified risk factors for postoperative infection include advanced age, diabetes mellitus, immunosuppression, obesity, systemic infection in the perioperative period, and extended hospitalization (17-23).

Marmara Medical Journal 2003;16(2):79-84

Correspondence to: Serdar Özgen, M.D, - Department of Neurosurgery, School of Medicine, Marmara University Hospital, Altunizade, 81190 Istanbul, Turkey.
e.mail address: omurga@tnn.net

The aim of this retrospective study was to investigate factors that may contribute to the development of discitis after lumbar macrodiscectomy. Antibiotic prophylaxis was one of the factors studied, and two different protocols were compared relative to discitis outcome and superficial wound infection (SWI).

MATERIALS AND METHODS

This retrospective study reviewed the cases of 2901 patients who underwent surgery for virgin lumbar disc herniation at our center between June 1986 and December 2001. The exclusion criteria were, previous operation for failed back surgery syndrome, accompanying spinal degenerative disease (e.g., lumbar spinal stenosis and/or spondylolisthesis), and previous spinal surgery involving instrumentation.

Preoperative Procedures: Prior to macrodiscectomy, each patient was neuroradiologically evaluated and underwent blood biochemistry analysis. For cases operated on from June1986 through December 1990, the radiological studies included plain radiography, myelography and computerized tomography. Patients operated from January 1991 through December 2001 underwent magnetic resonance imaging as well.

Perioperative Procedures: The same perioperative protocol was used in all cases. For preparation, the surgery site was shaved and cleansed twice with an antiseptic iodine solution. Other procedures aimed at preventing infection included draping of the operative site, use of antibiotics (as detailed below), and irrigation of the surgical field with physiologic serum at the end of the operation.

Standard lumbar macrodiscectomy was performed in each case. The disc material was removed, with careful attention paid to maintaining hemostasis and avoiding damage to the cartilaginous endplates. The skin was closed with absorbable subcutaneous sutures. All patients were mobilized the first day after the operation. Only analgesics and muscle relaxants were given postoperatively. The patients were discharged on postoperative day 3.

Antibiotics: Two different systemic antibiotic regimens were used. The group operated on before 1991 (Group 1; n=471) received a triple-antibiotic combination of intravenous penicillin G 2.4 g, chloramphenicol 50 mg/kg and gentamycin 2 mg/kg for 2 days. In these cases, the first doses were given in the operating room at the start of surgery. The group operated on between 1991 and 2001 (Group 2; n=2430) received a single intravenous dose of first-generation cephalosporin (cefazolin 1 g) 30 minutes before surgery.

Data Collected: The 2901 medical records were reviewed, and the patients who developed postoperative discitis were identified. For each of the 2901 cases, we recorded age, sex, history of diabetes mellitus, level of the herniated disc or discs, number of levels operated, occurrence of dural tear and cerebrospinal fluid fistula during surgery, and occurrence of postoperative SWI. The overall frequency of postoperative discitis was calculated, and frequencies of discitis were compared among the patients who were categorized by age, sex, study group (prophylactic antibiotic regimen), and spinal level operated. We also investigated the overall frequency of postoperative SWI, and the rates of this complication in the two study groups.

Statistical Analysis: Pearson Chi-Square and Fisher's exact test were used to analyze differences between the incidence rates of discitis and SWI in the two groups. P values <0.05 were taken to indicate statistical difference.

RESULTS

One thousand five hundred and seventy-three (54.2%) of the 2901 patients were male and 1328 (45.8%) were female. The age range in the study group was 14 to 75 years, and the mean age was 40.2 years. At the time of the operation, 91 of the patients had well-controlled diabetes mellitus. Nine individuals, none of whom was diabetic, developed discitis after lumbar discectomy; thus the incidence of postoperative discitis in our series was 0.31% (Table I). Five of the nine cases were in Group 1 (2-day course of triple-antibiotic prophylaxis) and four were in Group 2 (single dose of one antibiotic), so the corresponding group rates were 1.06% and 0.16%. The frequency of postoperative discitis in Group 2 was significantly lower than that in Group 1 (p<0.01) (Table II).

Five of the nine patients with postoperative discitis were male, four were female, and the mean age of the affected group was 46.5 years. When the 2901 patients were categorized according to sex and according to age group above 50 years, there were no significant differences with respect to frequency of discitis (p>0.05 for all). Analysis of discitis frequency relative to spinal level operated revealed 1 case (0.91%) in 110 L3-4 discectomies, 5 cases (0.36%) in 1392 L4-5 discectomies, and 3 cases (0.33%) in 899 L5-S1 discectomies (Table I). None of the patients with upper lumbar disc herniation developed postoperative discitis. All nine of the patients with this complication had undergone single-level discectomy.

None of the patients with discitis had problems with dural tearing or cerebrospinal fluid fistula formation during the surgery.

There were 26 (0.9%) postoperative superficial wound infections (SWI) in the 2901 cases. Only one of these 26 patients developed discitis. When the SWI cases were categorized according to prophylactic antibiotic regimen, there were 18 in Group 1 and 8 in Group 2. The rate of postoperative SWI in Group 2 (0.33%) was significantly lower than that in Group 1 (3.82%) (p<0.001) (Table III). There was no correlation between postoperative discitis and post-surgery SWI.

The initial symptoms in all the cases of postoperative discitis were low-back pain and muscle spasm, and the mean duration of symptoms was 14 days (range, 5-22 days). For management, all patients were immobilized and treated with antibiotics.

Table I: The occurrence of postoperative discitis in Groups 1 and 2 listed according to level of infection.

	Group 1	Discitis Cases	Group 2	Discitis Cases	Total	Total discitis
L1-2 HNP	2	-	11	-	13	-
L2-3 HNP	4	-	24	-	28	-
L3-4 HNP	33	1	77	-	110	1
L4-5 HNP	197	2	1195	3	1392	5
L5-S1 HNP	112	2	787	1	899	3
Two levels	115	-	331	-	446	-
Three levels	8	-	5	-	13	-
	471	5 (1.06%)	2430	4 (0.16%)	2901	9 (0.31%)

HNP: herniation of nucleus pulposus

Table II: Statistical comparison of the rates of postoperative discitis in Groups 1 and 2.

			Discitis +	Discitis -	Total
Group	1	n	5	466	471
		%	1.1%	98.9%	100%
	2	n	4	2426	2430
		%	0.2%	99.8%	100%
Total		n	9	2892	2901
		%	0.3%	99.7%	100%

	Value	df	Asymp.Sig. (2-sided)	Exact.Sig. (2-sided)
Pearson Chi-Square	10.263	1	0.001	
Fisher's Exact Test				0.008

Table III: Statistical comparison of the rates of superficial wound infection in Groups 1 and 2.

			Wound infection +	Wound infection -	Total
Group	1	n	18	453	471
		%	3.8%	96.2%	100%
	2	n	12	2418	2430
		%	0.5%	99.5%	100%
Total		n	30	2871	2901
		%	1%	99.0%	100%

	Value	df	Asymp.Sig. (2-sided)	Exact.Sig. (2-sided)
Pearson Chi-Square	42.692	1	0.00(p<0.001)	
Fisher's Exact Test				0.00(p<0.001)

DISCUSSION

Studies have identified advanced age, chronic malnutrition, obesity, diabetes mellitus, immunosuppression, steroid therapy, infection at remote sites, and prolonged preoperative hospitalization as the main risk factors for postoperative spinal infection (17,19-23). However, to date there has been no investigation of the factors that contribute to discitis after surgical treatment of lumbar disc herniation. In this retrospective study, we examined the cases of 2901 patients who underwent macrodiscectomy in a 15-year period. The surgical procedures were identical in all cases, but two different antibiotic prophylaxis regimens were used during this time.

As noted above, diabetes is a pre-existing condition that may predispose to infection. Simpson et al. compared outcomes after disc surgery in a diabetic patient population and a non-diabetic group (22). They reported infection in 10% of the diabetic patients and zero infectious complications in the non-diabetics. Recent studies have indicated that comorbid conditions associated with diabetes, such as cardiovascular problems, hypertension, and renal disease, are actually more serious risk factors for infection than isolated, well-controlled diabetes (19). Our large macrodiscectomy series included 91 (3.1%) diabetic patients, but none of these individuals developed discitis post-surgery.

The reported incidence of spondylodiscitis after lumbar discectomy ranges from 0.2% to 2% (3,4,8-16). According to the literature, the incidence of postoperative discitis in discectomy patients who do not receive antibiotic prophylaxis is as high as 3% (5,13,24-26). Numerous studies have shown that antibiotic prophylaxis effectively decreases the risk of infection after discectomy (8,9,12,27). Horwitz reviewed more than 500 lumbar disc operations and found that the overall infection rate fell from 9.3% to 1% after prophylactic antibiotics were added to the surgery protocol (28). In our series, we observed a 1.06% incidence of postoperative discitis in the patients who received 2 days of triple-antibiotic treatment, whereas the rate in patients who received single-dose single-antibiotic prophylaxis was only 0.16%. Statistical analysis showed that the single-dose single-agent (cefazolin) prophylaxis was significantly more effective at preventing lumbar discitis after macrodiscectomy than our multi-drug (penicillin G, chloramphenicol, gentamycin) regimen.

In addition to the use of prophylactic drugs in disc surgery, the timing of antibiotic administration is another important issue. The antimicrobial agent must be present at sufficient tissue concentration in order to be effective against anticipated pathogens (9). Work by Curries et al. showed that it takes a minimum of 2 hours for intravenously administered antibiotics to reach effective levels within the intervertebral disc (29). Animal studies and investigations in humans have confirmed that the intradiscal antibiotic level is only sufficient when the serum drug therapeutic level is adequate (27,29-33). It is also known that the antibiotic level measured in a disc is directly linked to the time elapsed since the drug was administered. Research has demonstrated that intradiscal antibiotic levels are highest 30 minutes after intravenous injection, so it is recommended that these agents be administered shortly before the disc space is surgically traumatized (31). From 1991 through 2001, we routinely administered one dose of intravenous antibiotic 30 minutes before the first incision was made in lumbar macrodiscectomy procedures. Our results show that this single-dose single-drug protocol is more effective against postoperative disc and SWIs than a triple-drug regimen in these cases.

In contrast, we found that other factors, such as age, sex, level of disc herniation, number of levels operated, and occurrence of dural tear and cerebrospinal fluid fistula during surgery were not correlated with postoperative lumbar discitis in this series.

The choice of prophylactic antibiotic for lumbar disc surgery is controversial. Optimal tissue penetration is important when attempting to prevent infection. First-generation cephalosporins are very effective against *Staphylococcus spp.*, which are the bacteria most commonly isolated from lumbar spine wound infections (26). Rhoten et al. demonstrated adequate penetration of the human cervical disc with cefazolin, but proposed a single 2-g intravenous dose of this drug prior to disc surgery (34). From January 1991 through 2001, we administered a single intravenous dose of first-generation cephalosporin (cefazolin 1 g) to each patient 30 minutes prior to macrodiscectomy. As detailed above, the incidence of postoperative discitis in these 2430 cases was 0.16%.

The main cause of postoperative discitis and postoperative SWI in macrodiscectomy cases is known to be inoculation of the wound site during surgery (1,28). In the past 20 years, many topical irrigants have been used in attempt to reduce the risk of infection (17,28,35,36). There is no agreement on the efficacy of topical agents for this purpose. Rosenstein et al. showed that, compared with no treatment, irrigation with bacitracin solution significantly decreased the frequency of infection in contaminated canine osseous tissue (37). In all 2901 cases in our series, the surgery site was prepared by shaving and performing two scrubs with antiseptic iodine. Proper draping procedures were used, and the surgical field was irrigated with physiologic serum at the end of the operation.

Numerous surgical factors are known to contribute to postoperative wound and disc infection, including introduction of foreign material, decreased tissue vascularity, and contamination of the surgical field (35,38). Obesity is also a risk factor for postoperative infection due to the increased incidence of hematoma formation in obese individuals. Hematomas are excellent culture media for bacteria. We did not investigate body weight as a factor in our study, but in the 2901 cases in this series, careful attention was paid to hemostasis, no suction drainage was used, and minimal tissue retraction was applied.

In conclusion, the overall incidence of postoperative discitis in our lumbar macrodiscectomy series was 0.31%. Of the factors we investigated, antibiotic regimen was the only one significantly associated with post-surgical discitis. The results showed that administering a single prophylactic dose of one antibiotic (cefazolin) 30 minutes prior to this type of surgery reduces the risk of postoperative lumbar discitis and SWI in this patient group.

REFERENCES

1. Ozgen S, Naderi S, Elmacı I, Ozek MM, Pamir MN. Lumbar disc herniations: Outcome analysis of 1473 operated patients. Neuro-Orthopedics 1999;27:43-53.
2. Ramirez LF, Thisted R. Complications and demographic characteristics of patients undergoing lumbar discectomy in community hospitals. Neurosurgery 1989; 25: 226-230.
3. Andrews DW, Lavyne MH. Retrospective analysis of microsurgical and standard lumbar discectomy. Spine 1990;15:329-335.
4. Blankstein A, Rubinstein E, Ezra E, Lokiec F, Caspi I, Horoszowski H. Disc space infection and vertebral osteomyelitis as a complication of percutaneous lateral discectomy. Clin Orthop 1987;225:234-237.
5. Ford LT, Key JA. Postoperative infection of intervertebral disc space. South Med J 1955; 78:1295-1303.
6. Fraser RD, Osti OL, Vernon-Roberts B. Discitis following chemonucleolysis. An experimental study. Spine 1986;11:679-687.
7. Leung PC. Complications in the first 40 cases of microdiscectomy. J Spinal Disord 1988;1: 306-310.
8. El-Gindi S, Aref S, Salama M, Andrew J. Infection of intervertebral discs after operation. J Bone Joint Surg Br 1976;58:114-116.
9. Fernand R, Lee CK. Postlaminectomy disc space infection. A review of the literature and a report of three cases. Clin Orthop 1986; 209:215-218.
10. Lindholm TS, Pylkkanen P. Discitis following removal of intervertebral disc. Spine 1982;7: 618-622.
11. Lowell TD, Errico TJ, Eskenazi MS. Use of epidural steroids after discectomy may predispose to infection. Spine 2000;15:516-619.
12. Pilgaard S. Discitis (closed space infection) following removal of lumbar intervertebral disc. J Bone Joint Surg Am 1969;51:713-716.
13. Puranen J, Makela J, Lahde S. Postoperative intervertebral discitis. Arch Orthop Scand 1984;55:461-465.
14. Rawlings CE, Wilkins RH, Gallis HA, Goldner JL, Francis R. Postoperative intervertebral disc space infection. Neurosurgery 1983;3:371-376.

15. Schulitz KP, Assheuer J. Discitis after procedures on the intervertebral disc. Spine 1994;19:1172-1177.

16. Tronnier V, Schneider R, Kunz U, Albert F, Oldenkott P. Postoperative spondylodiscitis: results of a prospective study about the aetiology of spondylodiscitis after operation for lumbar disc herniation. Acta Neurochir (Wien) 1994;117:149-152.

17. Cruse PJ, Foord R. A five-year prospective study of 23,649 surgical wounds. Arch Surg 1973;107:206-210.

18. Deyo RA, Cherkin DC, Loeser JD, Bigos SJ, Ciol MA. Morbidity and mortality in association with operations on the lumbar spine. The influence of age, diagnosis, and procedure. J Bone Joint Surg Am 1992;74:536-543.

19. Lawrie GM, Morris GC Jr, Glaser DH. Influence of diabetes mellitus on the results of coronary bypass surgery. Follow-up of 212 diabetic patients ten to 15 years after surgery. JAMA 1986;256:2967-2971.

20. Nelson CL, Green TG, Porter RA, Warren RD. One day versus seven days of preventive antibiotic therapy in orthpaedic surgery. Clin Orthop 1983;176:258-263.

21. Rawlings III CE, Wilkins RH. Postoperative intervertebral disc space infections. In: Wilkins RH, Rengachâry SS (eds). Neurosurgery. Vol 3. New York: MacGraw Hill, 1996:3825-3830.

22. Simpson JM, Silveri CP, Balderston RA, Simeone FA, An HS. The results of operations on the lumbar spine in patients who have diabetes mellitus. J Bone Joint Surg Am 1993;75:1823-1829.

23. Stolke D, Sollmann WP, Seifert V. Intra- and postoperative complications in lumbar disc surgery. Spine 1989;14:56-59.

24. Davis RA. A long-term outcome analysis of 984 surgically treated herniated lumbar discs. J Neurosurg 1994;80:415-421.

25. Riley LH 3rd. Prophylactic antibiotics for spine surgery: description of a regimen and its rationale. J South Orthop Assoc 1998;7:212-217.

26. Rubinstein E, Findler G, Amit P, Shaked I. Perioperative prophylactic cephazolin in spine surgery. J Bone Joint Surg Br 1994;76:99-102.

27. Riley LH 3rd, Banovac K, Martinez OV, Eismont FJ. Tissue distribution of antibiotics in the intervertebral disc. Spine 1994;19:2619-2625.

28. Horwitz NH, Curtin J A. Prophylactic antibiotics and wound infections following laminectomy for lumbar dischemiations: A retrospective study. J Neurosurg 1975;43:727-731.

29. Curries BL, Banovac K, Eismont FJ. Gentamycin penetration into normal rabbit nucleus pulposus. Spine 1994;19:2614-2618.

30. Eismont FJ, Wiesel SW, Brighton CT, Rothman RH. Antibiotic penetration into rabbit nucleus pulposus. Spine 1987;12:254-256.

31. Fraser RD, Osti OL, Vernon-Roberts B. Iatrogenic discitis: The role of intravenous antibiotics in prevention and treatment: An experimental study. Spine 1989;14:1025-1032.

32. Gibson MJ, Karpinski MR, Slack RC, Cowlishaw WA, Webb JK .The penetration of antibiotics into the normal intervertebral disc. J Bone Joint Surg (Br) 1987;69:784-786.

33. Guiboux JP, Cantor JB, Small SD, Zervos M, Herkowitz HN. The effect of prophylactic antibiotics on iatrogenic intervertebral disc infections. A rabbit model. Spine 1995;20:685-688.

34. Rhoten RL, Murphy MA, Kalfas IH, Hahn JF, Washington JA. Antibiotic penetration into cervical discs. Neurosurgery 1995;37:418-421.

35. Belzer FO, Salvatierra O Jr, Schweizer RT, Kountz SL. Prevention of wound infections by topical antibiotics in high-risk patients. Am J Surg 1973;126:180-185.

36. Dirschl DR, Wilson FC. Topical antibiotic irrigation in the prophylaxis of operative wound infections in orthopedic surgery. Orthop Clin North Am 1991;22:419-426.

37. Rosenstein BD, Wilson FC, Funderburk CH. The use of bacitracin irrigation to prevent infection in postoperative skeletal wounds. J Bone Joint Surg Am 1989;71:427-430.

38. Dauch WA. Infection of the intervertebral space following conventional and microsurgical operation on the herniated lumbar intervertebral disc. A controlled clinical trial. Acta Neurochir (Wien) 1986;82:43-49.