

Aerobic culture results of samples taken during lumbar disc herniation operations

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Abstract

Aim: This study aimed to determine the rate of aerobic bacterial infection in disc samples taken from the surgical field in patients with lumbar disc herniation (LDH) undergoing single-level lumbar microdiscectomy (LMD).

Material and Methods: Disc tissue samples were collected from the surgical fields in patients with single-level LDH undergoing elective LMD between September 2019 and May 2020. Tissues were then cultivated in cultures to determine the rate of aerobic bacteria and the results obtained were noted. The effects of parameters such as age, gender, affected side, Modic changes (MCs), and accompanying systemic diseases on culture results were statistically investigated. The patients were examined retrospectively with their demographic values.

Results: This study included 33 patients with single-level LDH and all of these patients underwent LMD. Two patients additionally underwent posterior lumbar instrumentation. The mean age was 50.87±12.20 years (25-71 years) and 17 (51.51%) of the patients were men and 16 (48.49%) were women. The mean follow-up duration was 3.03±1.64 months (1–8 months). Aerobic infection was observed in four patients (12.12%). Two of them (6.06%) were Enterobacteriaceae and the other two (6.06%) were coagulase-negative staphylococci (CNS). The antibiotic that patients were sensitive to was added to the postoperative medical treatment for two weeks according to the culture and antibiogram results. Age, gender, affected side, MC, and accompanying systemic diseases were found to have no statistically significant effect on culture results.

Conclusion: The prevalence of subclinical aerobic bacterial infection has been found to be 12.12% in patients undergoing LMD. Although sterilization rules have been strictly followed, the possibility of contamination of disc cultures could have not been completely rejected. In conclusion, the present study has shown that culture results have no effect on postoperative outcomes.

Keywords: Culture; discectomy; enterobacteriaceae; staphylococcus

INTRODUCTION

Low back pain and sciatica nerve pain due to lumbar disc herniation (LDH) are very common throughout the world. The LDH is associated with an inflammatory process caused by the nucleus pulposus on the nerve root. This process is associated with the local release of pro-inflammatory cytokines and pain mediators, which explains LDH-induced pain (1, 2).

Biochemical, mechanical, genetic, and toxic factors result in intervertebral disc (IVD) degeneration. The hypothesis of low-grade infection has been raised but not elucidated to date. Intraoperative biopsy and microbiological cultures were performed for each disc to determine if intradiscal bacteria were present. *Propionibacterium acnes* (*P. acnes*), *coagulase-negative staphylococci* (CNS), and *gram-negative bacilli* are the most common bacteria. The prevalence of bacteria has been found to be higher in males and at the L4-5 level. No significant relationship has been reported

between bacteria and Modic changes (MCs). Although contamination is not completely ruled out, bacteria have been reported to be involved in disc degeneration (3).

There are many studies demonstrating the presence of low virulence bacterial infection as a cause for degenerative disc disease. Some studies have reported a relationship between sciatica pain and disc cultures positive for *P. acnes*. However, discussions on this issue are still ongoing. Contamination that may occur during intraoperative sampling may not reflect actual subclinical infection rates. Therefore, the prevalence of subclinical infection may be high (4).

This study aimed to determine the prevalence of subclinical aerobic bacterial infection in patients with LDH undergoing single-level lumbar microdiscectomy (LMD) by investigating the relationship of positive culture results with age, gender, affected side, MC, and accompanying systemic diseases.

Received: 29.05.2020 **Accepted:** 29.09.2020 **Available online:** 21.10.2020

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MATERIAL and METHODS

Study Design

The data of patients undergoing a single level LMD, who were operated by a single surgeon in a single-center between September 2019 and May 2020 and whose aerobic bacterial culture was obtained, were retrospectively analyzed. All data were collected from the patient files in the electronic environment. All patients with LDH were diagnosed using magnetic resonance imaging (MRI) (Figure 1,2). The surgical technique to be applied was explained to the patients before the surgery in detail and their consents were obtained.



Figure 1. Preoperative sagittal and axial lumbar MRI images of a 32-year-old female patient with CNS-positive aerobic disc culture

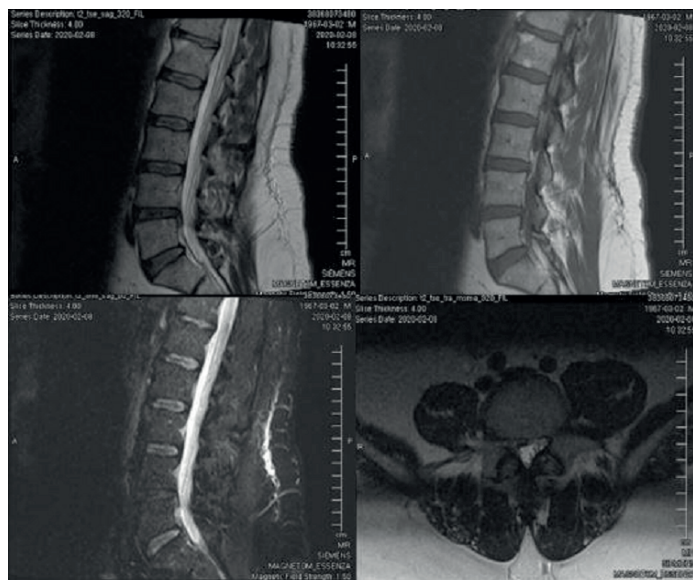


Figure 2. Preoperative sagittal and axial lumbar MRI images of a 52-year-old male patient with *Enterobacteriaceae*-positive aerobic disc culture

Inclusion and Exclusion Criteria

Patients who were diagnosed with single-level LDH did not respond to medical treatment within six weeks,

underwent LMD, and had normal preoperative C-reactive protein (CRP), sedimentation, and white blood cell (WBC) values were included in the study.

Those with multilevel LDH, spondylolisthesis, spinal fracture, spinal tumor, severe scoliosis, suspected spinal or disc infection, and abnormal preoperative CRP, sedimentation, and WBC values were excluded from the study.

Surgical Technique

The LMD operations were performed in a single center by a single neurosurgeon. Before the operation, a single dose of 1 g cefazolin was administered intravenously to all patients for prophylaxis. The operations were performed in the prone position under general or spinal anesthesia and the affected levels were determined via C-arm fluoroscopy. All patients underwent hemilaminectomy, microdiscectomy, and foraminotomy under the microscope. The nerve root was released and hemostasis was achieved. Tissues were closed with absorbable sutures. Tissue samples obtained from discs intraoperatively were sent to the laboratory for sterile bacterial examination and aerobic culture antibioticogram to reveal the presence of latent infection.

Evaluation Criteria

Disc tissues taken from patients following LMD were cultivated in the cultures required for aerobic bacteria, and the results were noted. Accompanying systemic diseases and MCs were investigated. The patients were examined retrospectively with their demographic values.

Statistical Analysis

The 2X2 contingency chi-square test was performed to compare aerobic culture results according to age, gender, affected side, MC, and accompanying systemic diseases. Since the degree of freedom was 1 and there were cells with an expected value of less than 5 in aerobic culture results, Fisher's Exact Test (χ^2) was performed (Dawson & Trapp, 2004) (Table 1).

Table 1. Descriptive statistics of the participants

	Frequency	Percent
Age		
25-50	11	33.3
50-71	22	66.7
Gender		
F	16	48.5
M	17	51.5
Left or Right LDH		
Right	22	66.7
Left	11	33.3
Modic Type Changes		
No Modic change	13	39.4
Type 1 or 2 Modic Changes	20	60.6
Accompanying Systemic Diseases		
No	22	66.7
Yes	11	33.3
Culture Results		
No	29	87.9
Yes	4	12.1

RESULTS

Patients' Characteristics

The data of 33 patients who underwent single-level LMD between September 2019 and May 2020 in our neurosurgery clinic and from whom disc tissue sample was collected for aerobic bacterial culture were retrospectively analyzed. Seventeen of the patients (51.51%) were male and 16 (48.49%) were female. The female-to-male ratio was 1:1. The age range of the patients was 25–71 years, with the mean age of 50.87±12.20 years. The level of 33 herniated discs, which were treated with LMD, was L2-3 in three (9.09%) patients, L3-4 in three (9.09%) patients, L4-5 in 16 (48.49%) patients, and L5-S1 in 11 (33.33%) patients. Eleven (33.33%) patients were operated for left LDH whereas 22 (66.67%) for right LDH. Three of these patients were re-operated due to recurrent LDH and posterior lumbar instrumentation was required in two patients in addition to LMD. The preoperative lumbar MRI showed no MC in 13 (39.39%) patients whereas there were type 1 MCs in two (6.06%) patients and type 2 MCs in 18 (54.54%) patients. When accompanying diseases were evaluated, six patients had hypertension, five patients had type 2 diabetes, two patients had hypothyroidism, one patient had coronary artery disease, and one patient had a neuropsychiatric disease. Bacterial growth was detected in aerobic bacterial cultures of four patients (12.12%). Two of them (6.06%) were *Enterobacteriaceae* and the other two (6.06%) were CNS (Table 3).

Statistical Analysis Results

Table 2 presents the Fisher's Exact Test results performed to compare the results of aerobic culture test according

to age, gender, affected side, MC, and accompanying systemic diseases. The analysis showed no significant difference between the aerobic culture test results in terms of age ($\chi^2=.569$, $p>.05$), gender ($\chi^2=.004$, $p>.05$), affected side ($\chi^2=.142$, $p>.05$), MC ($\chi^2=.395$, $p>.05$) and accompanying systemic diseases ($\chi^2=.142$, $p>.05$) (Table 3).

Complications

Patients with the presence of bacterial growth in their disc culture received medical treatment for two weeks in accordance with antibiotic susceptibility tests and no complications were observed during their follow-up. Wound infection was observed to develop in one of two patients who had no bacterial growth in their disc culture whereas there was oedema compatible with osteomyelitis in adjacent endplates in the other patient. Clinical response was observed in wound infection and osteomyelitis in the first and third months of the follow-up, respectively.

Table 2. Demographic and clinical characteristics of patients undergoing routine biopsy and culture during LMD

Study Population	Patients (n = 33)
Age (years, mean±SD)	50.87±12.20
Gender (n,%)	
Male	17 (51.51 %)
Female	16 (48.49 %)
Bacteriological disc aerobic cultures (n,%)	
Coagulase-negative staphylococcus (CNS)	2 (6.06%)
Enterobacteriaceae	2 (6.06%)

Table 3. Comparison of aerobic culture results according to age, gender, affected side, MCs, and accompanying systemic diseases

			Aerobic culture results			χ^2	p
			No	Yes	Total		
Age	25–50	f	9	2	11	.569	.40
		%	81.8%	18.2%	100.0%		
	50–71	f	20	2	22		
		%	90.9%	9.1%	100.0%		
Gender	F	f	14	2	16	.004	.68
		%	87.5%	12.5%	100.0%		
	M	f	15	2	17		
		%	88.2%	11.8%	100.0%		
Left or Right LDH	Right	f	19	3	22	.142	.59
		%	86.4%	13.6%	100.0%		
	Left	f	10	1	11		
		%	90.9%	9.1%	100.0%		
Modic Type Changes	No Modic change	f	12	1	13	.395	.48
		%	92.3%	7.7%	100.0%		
	Type 1-2	f	17	3	20		
		%	85.0%	15.0%	100.0%		
Accompanying Systemic Diseases	No	f	19	3	22	.142	.59
		%	86.4%	13.6%	100.0%		
	Yes	f	10	1	11		
		%	90.9%	9.1%	100.0%		

DISCUSSION

In a study conducted in 2018, which included 97 patients undergoing surgery for IVD degeneration and analysed the frequency and types of microbial infection in disc tissue, bacterial cultures were found to be positive in 27% of the patients undergoing discectomy. The most frequent pathogens were found to be obligate-anaerobic gram-positive bacteria (*P. acnes*) and epidermal staphylococci (*S. epidermidis*), in 42.8% and 31.4% of cases, respectively. The mixed microflora was detected in 20.0% of cases. Disc infection was found to have no significant relationship with chronic diseases and type 1 MC. The theory of microbial films was reported to be the most reliable mechanism of intervertebral disc infection (5). In a study involving 87 patients in 2016, a significant relationship was suggested between IVD disease and positive cultures. The most common bacteria in this study were *P. acnes* and *staphylococcus*. The positive culture rate was found to be 45% (6). In the present study, bacterial culture was positive in 12.12% of patients undergoing LMD. Examination of only the aerobic bacterial culture may be the reason for the low rates obtained from our study.

The MC is bone oedema in the vertebrae and has been shown to be associated with low back pain. There are three types of MC; type 1, type 2, and type 3. It can be only seen via MRI. One of two possible pathogenetic mechanisms that result in MC is due to low virulent anaerobic microorganisms (*P. acnes* and *Corynebacterium propinquum*). The other is explained by a mechanical cause (7). However, in a study published in 2018, bacterial growth was found to be positive in 26 (32.5%) of 80 IVD samples obtained from 80 patients. Twenty-one (26.25%) of these were *P. acnes* and five (6.25%) were CNS. The presence of bacteria has been reported to be significantly associated with MCs, but there is no significant association between bacterial infection and the severity of IVD degeneration (8). In a recent study investigating the relationship between type 1 MC and *P. acnes*, a total of 77 IVD samples were examined; 58 by anterior approach and 19 by posterior approach. The authors reported that this might be due to the contamination since *P. acnes* growth was higher in the posterior approach and that local infection did not support MCs, unlike many articles (9). In the present study, the relationship between aerobic bacterial culture and MC has been investigated and no significant relationship has been observed. Furthermore, the presence of CNS at a rate of 6.06% is quite parallel to the rate reported in this study.

In a retrospective study, latent infections were reported to be present in 9.3% of 162 patients undergoing revision spine surgery although there were no clinical signs of infection. Commonly used preoperative inflammatory markers such as sedimentation, CRP, and procalcitonin were reported to be not sensitive enough to identify latent infections (10). Patients with normal preoperative inflammatory markers were included in the present study. Therefore, the presence of latent infections was investigated.

The IVD degeneration caused by latent infection of low-virulence anaerobic bacteria is an interesting research topic. In a recent study, IVD samples were collected from 176 patients with LDH intraoperatively and sent to a bacterial culture test. Then, all patients were divided into three groups according to age; <30 years of age, 30–50 years of age, and >50 years of age. The most frequently growing bacteria were reported to be *P. acnes* and CNS and the prevalence and severity of infection was found to be higher in herniated IVDs of patients with <30 years of age. The prevalence of IVD degeneration has been reported to be higher particularly in young patients (11). In a meta-analysis published in 2019, in which 16 articles were examined, infection was detected in 12 of IVDs and the bacterial infection rate was found to be 25.3%. It was found that bacteria contribute to MC but this contribution was not significant (12). In the present study, there was no significant relationship between bacteria-positive discs and MCs. The mean age of our patients with a positive culture was 46.75±13.59 years (32–63 years).

In the English literature, the most frequent microorganism in the disc material has been reported to be *P. acnes* whereas the most commonly reproduced bacteria is CNS in some studies (13-16). In the present study, we could not provide a rate for *P. acnes* since only aerobic bacteria were cultured.

CONCLUSION

The latent infection rate of aerobic bacteria in disc tissue samples obtained during the LMD in patients with single-level LDH has been found to be 12.12%. Age, gender, affected side, MCs, and accompanying systemic diseases have no statistically significant effect on positive aerobic culture results. No clinical signs of infection have been observed during the follow-up of patients with bacteria-positive disc who received two-week antibiotic treatment.

Competing interests: The authors declare that they have no competing interest.

Financial Disclosure: There are no financial supports.

Ethical approval: Permission to use data from Medical Park Canakkale Hospital chief physician (approval number: 20.05.2020 / 293).

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