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Infection of the Intervertebral Space Following Conventional and Microsurgical Operation on the Herniated Lumbar Intervertebral Disc
A Controlled Clinical Trial

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Summary

Review of the literature reveals that considerable knowledge has accumulated on intervertebral space infection following lumbar disc surgery. This is based on more than 400 observations. There are, however, no unifying concepts regarding the pathogenesis of the condition. While the reported incidence has seemed to increase in the last three decades, we noticed a significant reduction in frequency of this important complication of lumbar disc surgery after introducing microsurgical techniques. The significance of this finding is discussed with respect to pathogenesis.

Keywords: Spondylitis; discitis; intervertebral disc displacement; microsurgery; erythrocyte sedimentation rate.

Introduction

Involvement of the spinal column in generalized infectious diseases like tuberculosis, smallpox, diphteria, measles and scarlet fever[16,23,31,56] in form of localized mono- or polysegmental spondylitis has been well known since the turn of the century (survey see[23,27,37]).

In 1936 Milward[42] described a new variant of this disease; following invasive diagnostic or therapeutic manoeuvres near the spinal column, there appeared signs of a complication which were similar to the well known haematogenic non-specific infectious spondylitis with respect to clinical findings: local back-ache, paravertebral muscular tenseness, fever, moderate leucocytosis, elevation of erythrocyte sedimentation rate (ESR). After several weeks, the radiological findings revealed narrowing of the intervertebral space, irregularities and sclerosis of endplates, later on fusion of vertebral bodies. In the German literature this complication was first described in the 50's following paravertebral infiltration therapy[33,64,78], paravertebral sympathetic nerve block[56,77], later after discography and in one case following an intervertebral disc operation.

On the occasion of the case report by Gieseking[18] a discussion was sparked off concerning aetiology: while Gieseking himself assumed operative activation of a pre-existing "discitis" to be responsible, Peiper[47] and Kley thought it to be some kind of non-infectious "spondylosis" caused by mechanical injury to the endplates of the vertebral bodies. Ziegler[78] and Laur[33] considered bacterial contamination as the cause of spondylitis which they had seen following paravertebral injection. This was the opinion as well of J. S. Barr, who described several cases of postoperative spondylitis in 1951[2].

Discussion about pathogenesis still continues, although the number of case reports on postoperative spondylitis exceeds 400. The pathogenesis is reflected by various concepts: as spondylitis (for instance[4,18,20,24,51,52]), discitis[3,35,36,44,49,50,62], spondylodiscitis[48,58,75], acute spondylosis[30,47], osteoarthritis[59], vertebral column osteomyelitis[6,33,78] or aseptic vertebral necrosis[57].

The clinical manifestations range from almost asymptomatic variants with mild radiological alterations with neither fever, leucocytosis nor elevation of ESR[21,35,51,57] to septic courses and occasional deaths[1,4]. Statements about incidence vary from between zero percent[11,19] to three percent[49] (Tab. 1). Numerous reports on the results of intervertebral disc surgery—including some from the seventies which

cover a large amount of clinical material—do not mention this complication at all. This raises questions about the number of undetected cases, particulary as the diagnosis seems to be somewhat difficult[32, 61, 72].

In view of the large discrepancies in the reported incidence of the disease, several authors[14, 38, 59, 61, 63, 76] have discussed the influence of operative techniques on the development of postoperative spondylitis. On the occasion of changing the operative technique in our clinic in 1982, to microsurgical methods, we took the opportunity to check its influence on the incidence of postoperative spondylitis.

Patients and Methods

From December 1980 to September 1982 we performed 250 operations on herniated lumbar discs using the so-called conventional approach (without microscope). This material is called group A. Operation was performed when there was myelographic or computerized tomographic evidence of a lumbar disc herniation with corresponding radicular pain, with or without neurological deficit. We performed a resection of the ligamentum flavum—and sometimes small parts of the vertebral arch—preserving intervertebral joints and their capsules as well as epidural fatty tissue (as described by Davis[9] and as early as 1939 by Love[39]) in the genupectoral position. Perforated disc material in the vertebral canal and/or in the intervertebral foramen was removed, the intervertebral space was cleared using forceps leaving the firm portions of anulus fibrosus unaltered. We did not use curettes. From October 1982 to November 1984 we performed another 231 operations on herniated lumbar disc, this time using the microsurgical technique, described by Caspar[8] and Loew[38] (Group B). Compared with the former method several changes were made:

— patient positioned on a resting splint
— magnification by operating microscope (OPMI 1, ZEISS, Oberkochen, Federal Republic of Germany)
— smaller extravertebral access

Table 1 a. *Incidence of Spondylitis Following Lumbar Disc Surgery.* References *without* special attention to this complication

Author	Year	Number of operations	Cases of spondylitis	Incidence
Jung[28]	1950	108	n.m.[1]	
O'Connell[43]	1950	500	n.m.	
Barr[2]	1951	495	m.[2]	
Diemath[10]	1958	182	n.m.	
Raaf[54]	1959	905	n.m.	
Gurdijan[22]	1961	1176	6	0.5%
Brown[5]	1963	570	n.m.	
Slepian[67]	1966	837	1	0.12%
Burke[7]	1971	88	n.m.	
Dunkerley[12]	1971	57	n.m.	
Diemath[11]	1973	433	0	0.0%
Horwitz[25]	1975	531	n.m.	
Thomalske[73]	1977	2000	n.m.	
Oppel[45]	1977	3198	n.m.	
Salenius[60]	1977	886	4	0.5%
Goald[19][3]	1980	447	0	0.0%
Wilson[76][3]	1981	400	9	2.3%
Ebeling[13][3]	1983	150	3	2.0%
			23	

[1] Not mentioned.
[2] Mentioned, not giving data on incidence.
[3] Microsurgical.

Table 1 b. *Incidence of Spondylitis Following Lumbar Disc Surgery.* References *with* special attention to this complication

Author	Year	Number of operations	Cases of spondylitis	Incidence
Turnbull[74]	1951	300	3	1.0%
Gieseking[18]	1951	?	1	
Brussatis[6]	1954	2000	4	0.2%
Ford[15]	1955	?	3	
Lenshoek[34]	1956	2000	3	0.15%
Kley[30]	1957	?	1	
Schultz[65]	1958	4000	5	0.13%
Sullivan[64]	1958	?	11	
Stern[68]	1959	?	9	
Barbieri[1]	1961	2000	8	0.4%
Salvi[80]	1962	2916	27	0.9%
Ruggeri[59]	1965	4962	16	0.3%
Bösch[4]	1965	1250	26	2.1%
Lowman[40]	1966	?	3	
Savini[61]	1968	2076	20	1.0%
Thibodeau[72]	1968	?	50	
Lang[32]	1968	?	8	
Pilgaard[49]	1969	502	15	3.0%
Reichenbeck[57]	1971	1000	5	0.5%
Scharfetter[62]	1971	500	3	0.6%
Teng[71]	1972	917	3	0.3%
Pilgaard[50]	1972	502	15	3.0%
Greiner[20]	1974	1492	23	1.5%
Grollmus[21]	1974	?	18	
El Ghindi[14]	1976	650	5	0.8%
Meining[41]	1977	2745	17	0.2/1%
Lester[35]	1978	918	22	2.4%
Twerdy[75]	1978	1345	16	1.2%
Taylor[70]	1978	?	14	
Baš[3]	1981	?	2	
Lindholm[36]	1982	3576	27	0.8%
Rawlings[55]	1983	4500	11	0.2%
Puranen[79]	1984	1100	8	0.7%
			402	

[1] Cited from[61].

— new instruments, including smaller forceps for clearing the intervertebral space.

There were no other alterations in the treatment. We used no prophylaxis, neither local or systemic antibiotics. Irrigation of the operative site was carried out solely with physiological sodium chloride solution and H_2O_2. There were no changes in the method of disinfection or sterilisation. All patients in both groups have been operated upon in the same operating theatre.

Every patient received identical medical treatment with antiphlogistics and vitamin B as well as prophylaxis for thrombosis. Each patient got out of bed on the first day after operation for several minutes. Approximately 80% of the operations (Group A: 79%, Group B: 85%) were performed by only three surgeons, in each of the rest one of these surgeons took part as an assistent. The operative technique was thus quite uniform. Characteristics of the two groups with regard to sex, age and involved segments are listed in Table 2. There are no relevant differences in any of these parameters. Distribution is nearly the same as described in other publications (for instance[11, 26, 45]). In both groups, there were 8% reoperations.

In every patient ESR was investigated pre-operatively and an on the 7th day after the operation.

We made the diagnosis of postoperative spondylitis whenever the following three criteria were met:

— Severe low back pain following lumbar disc surgery accompanied by paravertebral muscular spasm intensified by strain[21, 55, 62, 68, 69, 72, 75], with or without a latent period after the operation.
— Appearance of radiological signs of spondylitis not seen before operation, such as blurring, erosion or sclerosing of endplates, formation of spondylophytes, later on fusion of vertebral bodies[21, 35, 49, 68, 72, 75].
— Elevated ESR exceeding 18 mm/h, at least once postoperatively[14, 21, 32, 37, 41, 50, 55, 58, 62].

Clinical signs and symptoms played a leading role and triggered further diagnostic procedures. Follow-up examinations were made over a period of at least twelve months.

Results

We confirmed the diagnosis of postoperative spondylitis in eight patients, seven of them being operated upon by the conventional technique (2.8%, Group A), and only one by the microsurgical method (0.4%, Group B). That means a significant decrease of spondylitis since the introduction of the microsurgical technique ($p < 0.05$, χ^2-test).

With regard to all other clinical data no significant differences did exist between the two groups (Table 2).

Seasonal variation, described by Greiner[20], was confirmed neither in our material (winter 2, spring 1, summer 2, autumn 3), nor in the publication by Lindholm[36]. The surgical staff who performed the operations did not influence the incidence of spondylitis. Latency lay between one day and eleven weeks from operation to appearance of first symptoms of spondylitis, a period of time in general agreement with periods reported by others[20, 32, 36, 68]. The leading symptom was in every case severe low back pain intensified by movement, in two cases accompanied by moderate radicular pain. Neurological deficits, due to spondylitis, never occured.

ESR was elevated in 7 of 8 patients as early as the 7th day after the operation. Values ranged between 26 and 136 mm/h. The remaining patient showed an elevation of ESR only after the 3rd week. But elevated ESR (> 18 mm/h) was observed in some patients without spondylitis as well (Table 3).

White cell count was below 10,000 in every spondylitic patient. Moderate rise of body temperature (38–39 °C) was shown by two patients, starting on the second day after the operation, lasting 2 and 9 days, respectively. Bacteriological investigation of the tips of wound-drains revealed in three cases "micrococcaceae" (total group: 16%) without any evidence of superficial disturbances of wound healing. None showed signs of a meningeal reaction.

The first radiological signs of spondylitis appeared between 33rd and 89th day postoperatively. Antibiotics were given only to 2 patients who showed elevated body temperature in the first week after operation. Their administration continued until the 4th day after the fever had subsided. Immobilization in a plaster-bed produced a dramatic easing of pain within 3 or 4 days in every case.

Discussion

Courses of postoperative spondylitis observed in our patients were within the well-known variability of this disease, described by several authors mentioned above. Signs and symptoms, compiled from the literature (Table 1), are shown in Table 4 in comparison with our observations.

It is our opinion that postoperative spondylitis should not be diagnosed without elevation of ESR. In the large series of Lindholm (N = 33)[36], Savini (N = 14)[61], Sullivan (N = 11)[69] and Greiner, Pia and Schepelmann (N = 23)[20], ESR was elevated in every case. Rawlings[55] saw only one patient out of 27 showing ESR below 20 mm/h, but this was a patient treated with steroids. Only Lester[35] reports a considerable number of spondylitis patients with normal ESR (8 out of 22). No mention was made of time and number of investigations. We agree with Rawlings[55], who takes elevated ESR for an obligatory sign of spondylitis, being fully aware that it is in no way specific—as our data on patients without spondylitis

Table 2. *Characteristics of Patient Population and Frequency of Postoperative Spondylitis*

Group	A	B
Date of operation	Dec. 1980–Sept. 1982	Oct. 1982–Nov. 1984
Technique	conventional	microsurgical
Number of operations	250	231
Sex male	58.4%	58.5%
female	41.6%	41.5%
Age mean	43.5 years	43.1 years
<30 years	6.2%	10.1%
30–39 years	28.4%	27.2%
40–49 years	36.6%	38.3%
50–59 years	23.9%	15.4%
⩾60 years	4.9%	9.0%
One segment		
lumbar 2/3	0.4%	0.0%
lumbar 3/4	4.0%	3.5%
lumbar 4/5	49.6%	48.0%
lumbar 5/sacrum	41.2%	42.9%
Two segments	4.8%	5.6%
Spondylitis number	7	1
frequency	2.8%	0.4%*

* $p < 0.05$ (χ^2-test).

Table 3. *Frequency of at Least Moderately Elevated ESR (> 18 mm/h According to Westergreen) Prior to and 7th Day After Operation*

	N	One day before OP	7th day after OP
Group A (without spondylitis)	243	12%	29%
Group B (without spondylitis)	230	14%	24%
Patients with spondylitis (from Group A + B)	8	1/8	7/8

(Table 3) as well as those of Grollmus[21] and Kapp[29] suggest.

Since the middle of this century postoperative spondylitis has seemed to show an increase in frequency. Publications which can be evaluated with respect to this syndrome reveal a mean incidence of 0.2% in the fifties. 0.8% in the sixties and 1.4% in the seventies. The influence of better diagnostic accurary is not known. Meining[41] saw in his own material an increase of incidence from 0.16% (1950–1970) to 1.03% (1970–1975), as well as Puranen[79] in his recent paper.

Our finding is thus somewhat unique inasmuch as this complication has become less frequent in our homogeneous material. There was only one alteration made during the observed period: operative technique was changed in the manner described. Being very careful in interpreting the data obtained not from a prospective randomized study but from a trial with retrospective controls, we feel that relevant marginal conditions are of sufficient stability and that the running time of our trial is of sufficient shortness (4 years) to allow comparison of the two treatment

Table 4. *Signs and Symptoms of Spondylitis*

	According to literature		Own data	
	N	Frequency		
Low back pain	425	100%	8/8	obligatory
Radiological	425	100%	8/8	
ESR > 18 mm/h	193	84%	8/8	
Fever > 38 °C	188	34%	2/8	optional
Leukocytosis > 10000	151	19%	0/8	
Disturbances of wound healing	272	17%	0/8	

groups. Furthermore we assume that there is no justification for a prospective randomized trial in light of the several advantages of microsurgical technique mentioned elsewhere[13,19,38,76]. With this reservation we feel justified in infering from our material that the incidence of postoperative spondylitis is related to operative technique and is less frequent after microsurgery than after conventional surgery.

Influence of operative technique on frequency of spondylitis was already proposed by Savini[61]. His theoretical considerations take into account that injury to end-plates, maybe in combination with trauma to small vessels in this region and haematomas in the intervertebral space, may act as risk-factors for postoperative intervertebral disc space inflammation. He could not, however, support his suspicion by clinical data. Ruggieri[59] observed a significant drop in the incidence of intervertebral disc space infection, when performing the clearance of the intervertebral space more cautiously: simultaneously, however, he also introduced antibiotic prophylaxis. Opposing him, Schepelmann[63] and Loew and Caspar[38] assumed that no influence could be attributed to operative technique. Wilson[76] even saw a higher frequency after microsurgical treatment. Significance tests were not employed in this study, however. The considerations of Savini[61] also speak in favour of the microsurgical technique: its most important advantage seems to be the diminution of tissue trauma as was recommended by Savini.

Wilson[76] reports the halving of intraoperative blood loss, Loew[38] and Gould[19] saw less postoperative pain and shortening of hospitalization—indications of reduced trauma. This observation may explain our results: reduction of injury is responsible for the fact that germs which enter the operation area in small numbers with every operation (as with hematogenous spondylitis[17,31,46,48,66] so also in postoperative spondylitis mostly staphylococcus[1,14,15,25,32,36,55,58,68]) find a less suitable breeding ground and therefore are less frequently able to cause infections of clinical relevance.

One will have to await the results of further clinical investigations to show whether more careful clearing of the intervertebral disc space (which should include in our opinion practically all of the nucleus pulposus) has relevance with regard to the long-term results of lumbar disc surgery.

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