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Intrathecal steroids to reduce pain after lumbar disc surgery: a double-blind, placebo-controlled prospective study

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Summary

This double-blind, placebo-controlled prospective study investigated whether corticosteroids (beta-methasone) influence residual radicular pain after lumbar disc surgery. The study population consisted of 26 patients undergoing surgery for a herniated lumbar disc at our University Neurosurgical Department. Thirteen patients received beta-methasone intrathecally prior to wound closure, and 13 patients received normal saline. Main outcome measures were pain intensity graded on a 100-mm visual analogue pain scale (VAS) and consumption of non-steroidal anti-inflammatory agents (NSAIDs). Both patient groups had comparable presurgical findings and pain intensity level (55 mm and 54 mm, respectively, on a 100-mm VAS). After surgery, residual pain declined gradually in the placebo group (mean 39, 29, 24, 20 mm on days 1–4; 10 mm on day 8) and abruptly in the corticosteroid group (mean 15, 15, 11, 8, mm on days 1–4; 5 mm on day 8). Analysis of variance (ANOVA) showed a highly significant influence of time ($P < 0.001$), a significant influence of steroid application ($P = 0.014$) and interaction between time and application of steroids ($P = 0.042$). Mean daily consumption of NSAIDs did not differ significantly in either group: 124 mg in the treatment vs. 150 mg in the placebo group ($P > 0.25$). At follow-up after 6 months, residual radicular pain was rated equally by both groups (4 mm in the treatment vs. 5 mm in the placebo group, $P > 0.5$).

Intrathecal application of steroids provides short-lasting, statistically significant pain reduction after lumbar disc surgery. Benefits of intrathecal steroids are probably outweighed by the risks associated with violation of the dural barrier.

Key words: Corticosteroid; Beta-methasone; Surgery, lumbar disc; Radicular pain

Introduction

Despite atraumatic operative technique and good decompression of nerve roots, postoperative radicular pain can be experienced by patients undergoing lumbar disc surgery.

The use of steroids, applied either epidurally or intradurally, to reduce radicular pain in general is controversial. A growing literature favors the epidural application of steroids for its efficacy and safety (Gardner et al. 1961; Goldie and Peterhoff 1961; Dilke et al. 1973; Brown 1977; Delaney et al. 1980; Kepes and Duncalf 1985; Benzon 1986; Glasser et al. 1993). Only a few reports deal with corticosteroids applied intrathecally (Boins 1964; Kulik 1965; Lehrer et al. 1973; Bernhard et al. 1974; Hartmann et al. 1974; Bernat 1981; Kneizel 1976), most of which regard intrathecal (i.t.) application as a possibility in the conservative treatment of lumbar radicular pain (Boins 1964; Bernhard et al. 1974; Hartmann et al. 1974; Bernat 1981). The influence of i.t. steroids on residual radicular pain after lumbar disc surgery has rarely been investigated.

Our randomized, double-blind, placebo-controlled clinical trial was undertaken to determine whether the i.t. administration of steroids provides any benefits

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with regard to immediate postoperative and long-term radicular pain in patients undergoing discectomy for lumbar disc herniation.

Patients and methods

Characteristics of the study population

Between March 1993 and November 1993, 462 patients underwent lumbar disc surgery at the Universitätsklinik für Neurochirurgie in Innsbruck, Austria. Twenty-six of these patients met the study criteria and gave their informed consent to participate in the study. Inclusion criteria were presence of pain resistant to non-surgical treatment caused by unilateral, single-level lumbar disc herniation confirmed by either computed tomography or myelography. Patients with other causes of radicular pain such as prior lumbar surgery, evidence of systemic neurological disease or major medical illness were excluded.

Pre-operative pain ranged from 14 to 150 days (Table I) and was quantified on a visual analogue scale (VAS) ranging from 0 to 100 mm (Ohnhaus and Adler 1975). Signs, side and level of disc herniation are listed in Table I. Lasegue's sign is given in degrees, with steps of 10 and a maximum of 90°. Paresis was graded by using a 0–5 scale with 0 = no contraction and 5 = normal power. Sensory disturbances were classified as present or absent. Patients were prospectively randomized in 2 groups. The first group received 2 ml of i.t. beta-methasone (Solu-Celestan, SP Labo, Heist, Belgium) prior to wound closure (group 1, n = 13), and the second group 2 ml of normal saline (group 2, n = 13).

The study design was approved by the Ethics Committee of the Medical Faculty of the University of Innsbruck, Austria.

TABLE I

DEMOGRAPHIC DATA, SIGNS AND SYMPTOMS OF PLACEBO (n = 13) AND STEROID GROUP (n = 13)

Age is represented as mean, Lasegue's sign in degrees as median and pre-operative duration of pain in days as median. Other values are numbers of patients for each subgroup. Differences between groups were not significant ($P > 0.1$).

	Placebo	Steroid
Age (mean)	40	44
Sex (female/male)	3/10	3/10
Side (right/left)	5/8	7/6
Nerve root (L4/L5/S1)	2/5/6	0/6/7
Duration of radicular pain (median)	42	28
Pre-operative		
Lasegue (median)	40	30
Sensory disturbance (yes/no)	12/1	12/1
Muscle power (5/4/3/2/1/0)	9/3/1/0/0/0	11/1/0/0/1/0
At discharge		
Lasegue (median)	60	60
Sensory disturbance (yes/no)	8/5	7/6
Muscle power (5/4/3/2/1/0)	8/5/0/0/0/0	11/1/1/0/0/0
Follow-up (n = 24)		
Lasegue (median)	90	90
Sensory disturbance (yes/no)	6/6	6/6
Muscle power (5/4/3/2/1/0)	9/3/0/0/0/0	10/2/0/0/0/0

Operative technique

Surgery was performed under general anesthesia and in knee-chest position. Each patient underwent a standardized discectomy

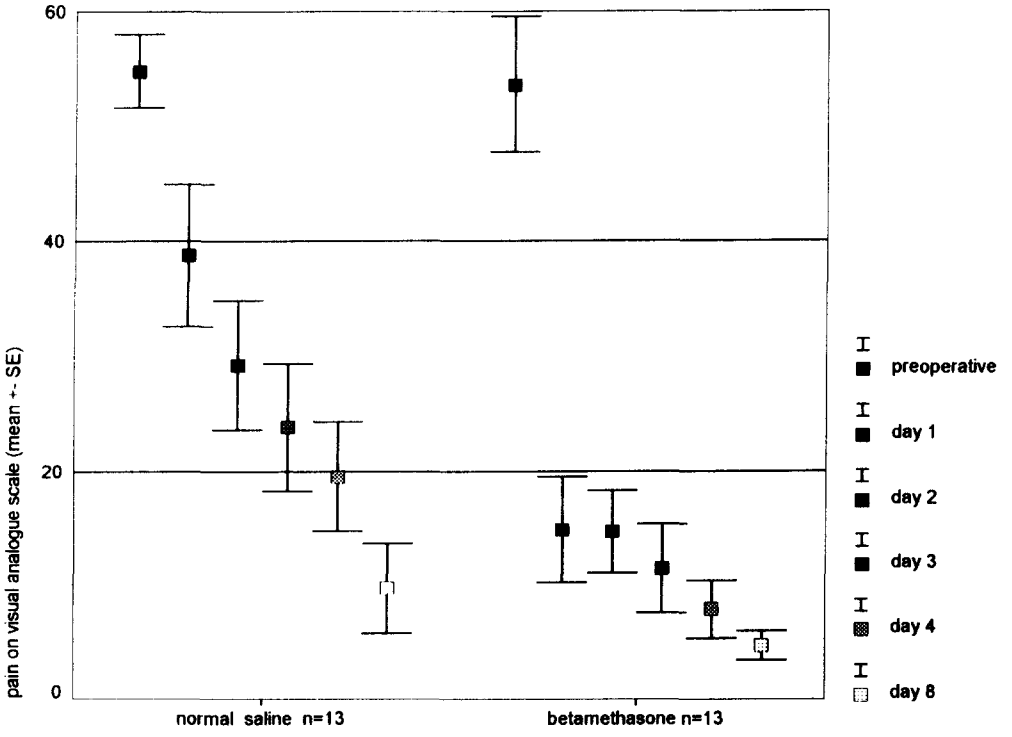

Fig. 1. Mean and standard error of pain intensity level marked by the patients on the VAS. The first column of each group represents the pre-operative evaluation; the other columns show the postoperative pain course on p.o. days 1–4 and 8.

without the use of microscope, consisting of partial hemilaminectomy, removal of offending disc material and curettage of the intervertebral space. At the end of the operation either 2 ml of betamethasone or 2 ml of saline was administered intrathecally using a 25-ga needle.

Postoperative course and evaluation

All patients were mobilized on the 1st day after surgery and discharged on the 8th postoperative day according to a standardized protocol. Diclofenac as a NSAID was administered routinely during hospital stay at a dose of 50 mg 3 times a day; the dose was adjusted to patients needs.

All patients were instructed how to use a VAS. The first measurement was conducted with the surgeon 1 day before surgery. On days 1–4 patients used the VAS on their own; data were collected each day at the afternoon round. Patients were explicitly asked to grade only their radicular pain for that day.

On the day of discharge each patient was examined and once again assessed pain on the VAS.

Follow-up examination was conducted after 6 months by an independent investigator not involved in surgery or postoperative care of the study population. One patient in each group was lost to follow-up.

Doctors participating in surgery, postoperative care, postoperative examination and follow-up examination were unaware of the solution given intrathecally, as were patients.

Statistics

Quantitative variables were analyzed by means of the t test, ordinal data with the Mann-Whitney U test. Frequencies were compared with the chi-square test. Repeated measurements were analyzed using the particular analysis of variance (ANOVA). P values less than 0.05 were considered significant.

Results

Treatment and control groups were comparable for age (t test), sex, side and level of disc herniation (chi-square test). There were no significant differences in sensory disturbances, muscle power (chi-square test), sign of Lasegue or pre-operative duration of pain (Mann-Whitney U test) (Table I).

Patients who received i.t. steroids experienced less pain during the first postoperative days as compared with the control group. Fig. 1 shows the pain rating given by the patients on the VAS. Pain intensity level in the placebo group (mean ± SE) was 55 ± 3.2 pre-operatively; 39 ± 6.1; 29 ± 5.6; 24 ± 5.6; 20 ± 4.8 on days 1–4 and 10 ± 4 on day 8; pain intensity level in the steroid group was 54 ± 5.9 pre-operatively; 15 ± 4.7; 15 ± 3.6; 11 ± 3.9; 8 ± 2.5 on days 1–4 and 5 ± 1.3 on discharge. For statistical confirmation we used an ANOVA with repeated measurements. The between-subjects factor was the use of steroids, within-subjects factor was time (levels measured: pre-operative day, postoperative days 1–4 and day 8). The analysis showed a highly significant influence of time ($P < 0.001$), but also a significant influence of steroids ($P = 0.014$) and interaction between time and application of steroids ($P = 0.042$), which reflects the sharp decrease in pain experienced by the steroid group.

There was no statistically significant difference in the dosage of diclofenac in either group (mean daily dosage, group 1: 124 mg, SE 22.5 mg; group 2: 150 mg, SE 18.3 mg; Student's t test: $P > 0.25$).

Follow-up examination 6 months after surgery revealed no difference in residual radicular pain as measured with the VAS method. Since distribution was not normal, we used a non-parametric test to compare both groups: median group 1 (n = 12): 4 mm; median group 2 (n = 12): 5 mm; Mann-Whitney U test: $P > 0.5$.

No complications associated with dural puncture were observed in the study population.

Discussion

Steroids are of value in the non-surgical therapy of back pain, either alone or in conjunction with anesthetics (Feffer 1956; Goldie and Peterhoff 1961; Dilke et al. 1973; Marschall et al. 1977). Success ranges from 20% to 95%, but this is hardly scientifically proven (Kepes and Duncalf 1985). In surgical patients undergoing discectomy the authors of a recent study found a statistically significant shorter hospital stay and reduction of postoperative discomfort after epidural intraoperative application of bupivacaine and corticosteroids (Glasser et al. 1993).

The i.t. injection of steroids after disc surgery has rarely been investigated (Sehgal and Gardner 1960; Hartmann et al. 1974; King 1984). Some authors reported favorable results for injection of steroids alone (Goldie and Peterhoff 1961; Lehrer et al. 1973; Bernhard et al. 1974; Winnie et al. 1972; Vent 1981) or in combination with local anesthetics (Goldie and Peterhoff 1961; Lehrer et al. 1973; Bernhard et al. 1974; Schock and Wieczorek 1974; Brown 1977). Most of these papers were not controlled.

In our placebo-controlled report, patients with herniated lumbar disc surgery had significantly less radicular pain on postoperative days when beta-methasone was injected intrathecally prior to wound closure. The effect vanishes during subsequent days, reaching no longer statistical significance at discharge and after 6 months.

Intrathecal application of steroids might have two main advantages as compared with the extradural route (Naylor et al. 1977; Bernat 1981). (1) High local concentrations can be obtained, allowing a lower dosage and therefore a reduction in systemic effects (Lehrer et al. 1973). According to Sehgal, 40–80 mg of Depo-Medrol injected intrathecally remains present in the cerebrospinal fluid for as long as 3 weeks (Sehgal and Gardner 1963). This might be caused by a slower

clearing of the injected drug due to mechanical or chemical irritation of the arachnoid membrane (Schock and Wieczorek 1974; Schenk 1976). (2) The 'wash-out' effect associated with the use of suction drainage and residual rinsing solutions in the operative field can be avoided by placing corticosteroids intrathecally.

Disadvantages of i.t. application of steroids are mainly due to violation of the dural barrier and include (1) the possible induction of arachnoiditis due to the irritating effect of bacteriostatic agents and solubility-altering vehicles introduced in the cerebrospinal fluid (Nelson et al. 1972), (2) the increased risk of bacterial meningitis, (3) the possibility of cerebrospinal fluid (CSF) leakage and subsequent risk of development of a CSF fistula, and (4) the possible induction of seizures (Parkhurst et al. 1971).

We did not observe any of the disadvantageous effects of beta-methasone when applied intrathecally, but our study population is too small to draw meaningful conclusions in this regard and the methods used were not able to detect arachnoiditis.

The effects observed in our study might be due to an altered inflammatory reaction following i.t. corticosteroids. Changes within spinal nerve roots during and after surgical decompression are poorly understood. We speculate that either an already present inflammation is aggravated by the surgical trauma, or surgery itself initiates a local inflammatory response in the root or the surrounding meningeal coverings. Swelling of the nerve root after surgical manipulation might compromise space within bony structures and be amenable to the well-documented anti-edematous effects of cortisone (Marschall et al. 1977). Intrathecal steroids prevent the development of reticulin networks and cellular elements of the primitive arachnoid adhesions (Feldman and Behar 1961) and might inhibit the formation of pia-arachnoidal adhesions (Bernat 1981).

For the VAS we explicitly asked our patients to grade their radicular pain only. Nevertheless, we cannot rule out the possibility that individual pain ratings were influenced by pain common to all surgical procedures, namely from tissue manipulation and postoperative inflammation.

An effect similar to the one observed in our study might be obtained through adequate therapy with oral, parenteral or epidural application of steroids. In a randomized prospective study King investigated the use of a potent anti-inflammatory steroid (Dexamethasone, i.v., i.m., p.o.) during the perioperative period (King 1984).

In conclusion, postoperative pain is markedly reduced when a corticosteroid is applied intrathecally during surgery. Considering the short-lasting effect, the results obtained by other authors with less invasive administration routes and the possible negative consequences of dural violation, we cannot recommend the routine use of i.t. corticosteroids in patients undergoing lumbar disc surgery.

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