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## *Incidence of Spinal Epidural Abscess after Epidural Analgesia*

### *A National 1-year Survey*

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EPIDURAL analgesia is most often used for postoperative pain relief, whereas it is no longer so commonly used for long-term treatment of pain from malignant diseases. For perioperative use, the epidural catheter is most frequently inserted before induction of anesthesia while the patient is awake, although there has recently been some debate as to whether regional techniques should or should not be performed during general anesthesia.<sup>1</sup> Side effects of epidural analgesia are common,<sup>2</sup> but the majority are innocuous and well known to anesthesiologists. However, two serious complications of epidural analgesia may result in severe morbidity: the spinal epidural hematoma and the spinal epidural abscess. In a recent editorial,<sup>3</sup> the incidence of spinal epidural hematoma after epidural analgesia in association with the use of low-molecular-weight heparin was estimated to vary from 1:1,000 to 1:10,000 epidural procedures, which is much higher than previously thought. The incidence of spinal epidural abscess after epidural analgesia remains unknown but has been reported to vary widely. No cases of epidural abscess were found in a large Swedish study of 9,232 epidural procedures,<sup>4</sup> whereas there were two cases of abscess formation among 13,000 epidural procedures in a German report,<sup>5</sup> and 3% of the patients in a smaller North American study developed epidural ab-

cess after long-term epidural treatment of chronic pain.<sup>6</sup> The incidence has also been reported to vary from 0.6 to 0.77 per 1,000 catheter days.<sup>7,8</sup>

The present study was undertaken to estimate the incidence of epidural abscess after epidural analgesia in Denmark during a 1-yr period and to evaluate the overall use of epidural analgesia during the same period. We further wished to analyze the treatment and outcome in patients with spinal epidural abscess.

### Materials and Methods

All anesthetic departments in Denmark were invited in writing to participate in a prospective 1-yr study of patients with epidural abscess after epidural analgesia from May 1, 1997, to April 30, 1998. After a reminder was sent to departments that failed to respond to the initial invitation, a questionnaire was distributed to the participating departments. The questionnaire was to be completed when a patient developed an epidural abscess after epidural analgesia, and in each department a local coordinator was responsible for the collection and transfer of data for the relevant patients. Because the anticipated total number of epidural procedures during the 1-yr study period was high, only information about patients who developed an epidural abscess or in whom the diagnosis was suspected (*i.e.*, were referred for neurosurgery) was requested. Epidural catheterization was classified as complicated (multiple attempts) or uncomplicated (straightforward).

No single method was used at all departments to identify all patients with complications after epidural catheterization. All Danish physicians were informed about the ongoing study through the *Danish Medical Journal*,<sup>9</sup> and the coordinators were reminded at regular intervals of the progress of the study. Patients with indwelling (long-term) epidural catheters were exam-

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ined on a regular basis by an anesthesiologist according to local routines to ensure that the epidural analgesia was working and to renew the content of the epidural infusion pump.

A national identification system (Central Personal Registry) based on a person's date of birth plus a four-digit number, which, taken together, is unique to that person, is used in all cases of contact with the Danish health care system. This central identification facilitates subsequent tracking of any given individual within the society. Furthermore, a national coding system of diagnoses and surgical procedures facilitates cross-checking information about specific hospital admissions. The Danish population of 5.5 million people is predominantly white and may be considered fairly homogenous from racial and social points of view. Therefore, the study population was relatively closed and well documented.

At the end of the study period, the number of epidural catheters used in each department was calculated. Patients who developed epidural abscess at the end of the study period, after an epidural catheter had been inserted during the study period, were to be included ( $n = 0$ ). The follow-up of patients with spinal epidural abscess was terminated at the most recent hospital discharge as documented in the patients' notes. The ethics committee waived the need for consent.

### *Data Verification*

Local variations in the facilities available for departmental recording of anesthetic activities during the study period accounted for interhospital differences in the calculation of the number of epidural catheters. The number of catheters used during the study period may either be calculated from number of catheters in stock on May 1, 1997, plus the catheters purchased during the study minus the stock on April 30, 1998, or may be derived from computerized registration of epidural anesthetics. The validity of the latter method was tested at one university hospital where 88% of the purchased catheters (2,900 of 3,285) were used during the 1-yr period. Allowing for a 10% waste rate (*e.g.*, because of technical problems), this figure suggests an acceptable correlation between the two numbers. As for patients with epidural abscess after epidural analgesia, the combination of a national system of coding of diagnoses and surgical procedures and the Central Personal Registry made it possible to identify all patients referred to neurosurgical departments with a

diagnosis of spinal epidural abscess during the study period, and to cross-match admitted patients and operating lists with the patients with epidural abscess. This analysis of data was performed by the authors. A manual review of the neurosurgical operating lists at six neurosurgical departments was performed by the authors in four cases and by the chiefs of neurosurgical departments in two cases.

After the study period, three subgroups of epidural procedures were analyzed: (1) catheterization time was studied in 343 epidural procedures from one university hospital; (2) level of catheterization was investigated in a subgroup of 2,171 patients from two university hospitals and two nonuniversity hospitals; and (3) indications for epidural analgesia were studied in 1,795 patients from one university hospital and four nonuniversity hospitals.

### *Statistics*

Results are presented as mean  $\pm$  SD. Intergroup comparisons were analyzed by chi-square test with Yates correction and  $P$  values  $< 0.05$  were considered indicative of statistical significance.

## Results

Forty-six of 59 departments participated in the study. This represents 78% of anesthesia departments in Denmark, covering a population of 4.5 million people. There were 12 participating university departments and 34 nonuniversity departments; two university departments and 11 nonuniversity departments chose not to participate. Sixty-eight percent of the epidural procedures were performed at the university departments. Twenty-three of 44 anesthetic departments (52%) possessed computerized registration of epidural anesthetics, and 21 departments (48%) used stock recording for calculation of the number of catheters used. Two departments did not use epidural anesthesia. A total of 17,372 epidural catheters were used during the 1-yr period.

Data from 12 patients with possible epidural abscess formation were collected. Nine of these 12 patients had developed a true spinal epidural abscess, two had subcutaneous infections, and one suffered from sequelae from a misplaced epidural catheter. However, only the nine cases of epidural abscess are considered here. These cases occurred at eight different departments. No cases were identified in neurosurgical departments that had not already

**Table 1. Symptoms and Treatment in Nine Patients with Epidural Abscess after Epidural Catheter**

|                                     | Patient 1       | Patient 2       | Patient 3       | Patient 4       | Patient 5       | Patient 6       | Patient 7    | Patient 8 | Patient 9 |
|-------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|--------------|-----------|-----------|
| Level of insertion                  | T9/10           | L3/4            | T4/5            | L3/4            | L4/5            | T6/7            | T7/8         | T8/9      | L2/3      |
| Catheterization period              | 3 days          | 3 days          | 6 days          | 7 days          | 6 days          | 16 days         | 31 days      | 3 days    | 26 days   |
| Local signs                         | yes             | no              | yes             | yes             | yes             | yes             | yes          | no        | no        |
| Fever                               | yes             | no              | no              | yes             | yes             | yes             | yes          | no        | no        |
| Neurologic deficits preoperatively  | yes             | yes             | yes             | yes             | yes             | yes             | no           | no        | yes       |
| Surgery                             | yes             | yes             | yes             | yes             | yes             | yes             | no           | no        | yes       |
| Neurologic deficits postoperatively | yes             | yes             | yes             | no              | no              | yes             | no           | no        | no        |
| Delay                               | 5 days          | 6 days          | 6 days          | 15 days         | 1 day           | 4 days          | 32 days      | 1 day     | 4 days    |
| Bacteria                            | <i>S.aureus</i> | <i>S.aureus</i> | <i>S.aureus</i> | <i>S.aureus</i> | <i>S.aureus</i> | <i>S.aureus</i> | <i>S.epi</i> | ?         | ?         |
| Immunocompromized                   | yes             | yes             | yes             | yes             | no              | yes             | yes          | yes       | yes       |
| Thromboprophylaxis                  | LMWH            | LMWH            | No              | LMWH            | LMWH            | LMWH            | No           | LMWH      | No        |

T = thoracic; L = lumbar; ? = no bacterias isolated; Delay = time from first symptoms to confirmation of diagnosis; Immunocompromized = patients with malignancy, diabetes mellitus, multiple trauma; LMWH = low-molecular-weight heparin; *S. epi* = *S. epidermidis*.

been registered by the coordinators. The incidence of spinal epidural abscess after epidural analgesia was 1:1,930 catheters. The incidence of epidural abscess was 1:5,661 catheters at the participating university hospitals, and 1:796 catheters at the nonuniversity (community) hospitals ( $P < 0.01$ ). Case reports of the nine patients with epidural abscess are presented in the appendix.

#### Catheterization Time

The catheters remained *in situ* for a mean of 11 days ( $11.2 \pm 3.6$  days) and a median of 6 days (range, 3–31 days; table 1).

#### Level of Catheterization

Of the nine patients with epidural abscess, five had a thoracic catheter placement, whereas a lumbar epidural catheter was inserted in the other four patients (table 1).

#### Indication for Epidural Analgesia

In the nine patients with epidural abscess, 67% received epidural analgesia for perioperative pain relief, 22% for cancer pain, and 11% for trauma-related pain. Low-molecular-weight heparin was given as thromboprophylaxis before epidural catheterization in six of nine patients.

Symptoms and signs of meningitis (fever, meningismus, headache) were found in 11% of the patients, 56% of the patients were febrile, and 67% had signs of local infection (table 1). Sixty-seven percent complained of localized back pain, and 78% developed neurologic disturbances such as lower-limb paraplegia, urinary or fecal incontinence, or irradiating pain (table 1).

The time from appearance of the initial symptoms of development of an epidural abscess to the time diagnosis

was established varied from 1 to 32 days (mean,  $8.2 \pm 9.9$  days; median, 5 days). For patients undergoing neurosurgical decompression of the spinal cord ( $n = 7$ ), the mean time from first symptoms to confirmation of the diagnosis was  $5.9 \pm 4.0$  days (median, 5 days). *Staphylococcus aureus* was isolated in six patients (67%). Coagulase-negative cocci were found in one patient, and no bacteria were found in two patients (table 1). Bacteremia was diagnosed in two patients (*S. aureus* in one case and *Staphylococcus epidermidis* in one). All patients received intravenous antibiotic treatment.

Seven patients with neurologic deficits underwent neurosurgical decompression of the spinal cord within 24 h of verification of the diagnosis, and two patients were treated successfully with antibiotics and were discharged free of neurologic symptoms. Four of the patients who underwent surgery developed persisting neurologic deficits (table 1); two patients suffered severe paraplegia, and two developed paraparesis. The risk of persisting neurologic deficits was 1:4,343 catheters. Magnetic resonance imaging (MRI) was used in eight of nine patients to establish the diagnosis of spinal epidural abscess, and computed tomography plus myelography was used in one patient.

For comparison, three subgroups of patients were analyzed. A subgroup of 343 catheters at one university hospital was analyzed for details of the catheterization period. In this group, the median and mean catheterization time was 3 days (range, 1–10 days) and 3.5 days, respectively (fig. 1). A subgroup consisting of epidural procedures from two university and two nonuniversity departments were analyzed in detail with respect to the level of catheterization. At the university hospitals, 863 catheters were used; 80% of these were thoracic and

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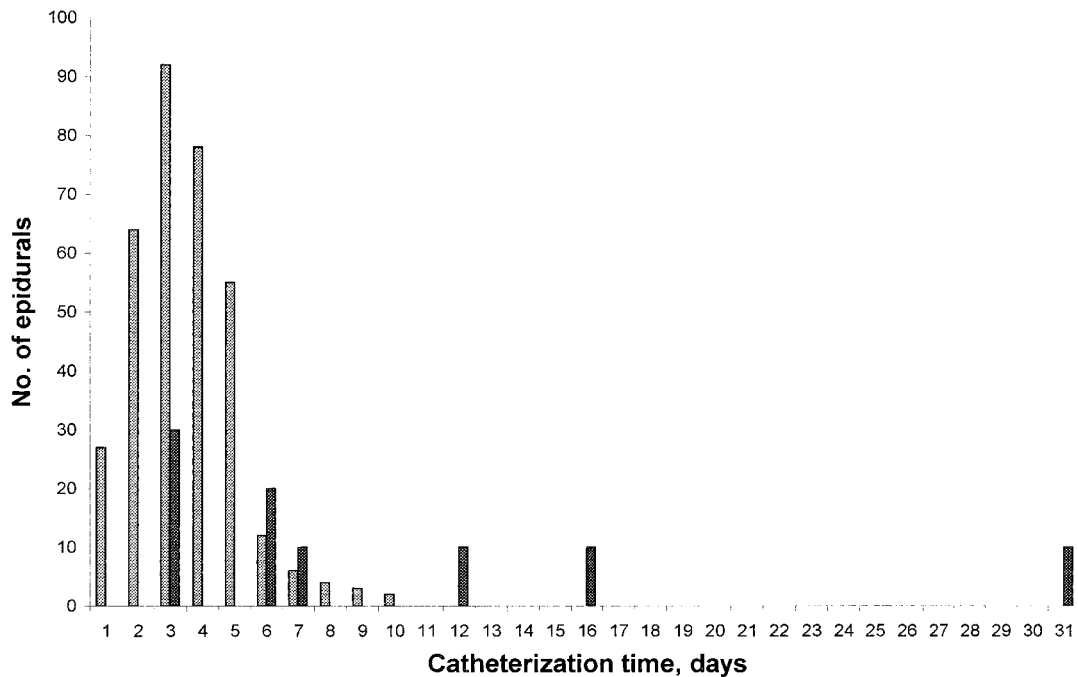


Fig. 1. Catheterization time in 343 patients from one university hospital (light shaded bars) and nine patients with epidural abscess (dark shaded bars; ordinate in 1/10).

20% lumbar. At the nonuniversity departments, a total of 1,308 epidural catheters were inserted: 33% thoracic and 67% lumbar. The indications for epidural catheterization were analyzed in a subgroup of 1,795 patients. Eighty-seven percent of the epidural catheters were inserted for perioperative pain relief (including obstetric analgesia), 9% of the patients were trauma victims, and 4% had an epidural catheter inserted for relief of cancer related pain. The findings of these comparisons may not be entirely representative of the total study population. However, the hospitals were selected at random, and the total number of catheters in the subgroups included 24.8% of all epidural procedures.

## Discussion

The large majority of the anesthetic departments indicated that registration and later follow-up of every epidural anesthetic procedure would not be possible. Subsequently, we planned the study so that a staff member at each department immediately conveyed data of patients who developed epidural abscess after epidural analgesia to the authors. Furthermore, the

medical community was informed of the study in an article appearing in the *Danish Medical Journal*,<sup>9</sup> which is received by all Danish physicians. Because of the severity of the complication, we believe it is unlikely that cases were not reported, but because of the study design, the true incidence of epidural abscess may be even higher than calculated here. However, no further patients were admitted to the neurosurgical departments, and in our opinion, the incidence reported here is nearly accurate.

During a 1-yr period, a total of 17,372 epidural catheters were used in a population of 4.5 million people. Approximately 400,000 anesthetics are given in Denmark each year.<sup>10</sup> Subsequently, epidural analgesia was used alone or in combination with general anesthesia in 6% of all anesthetic procedures. In a recent review of the European anesthesiology literature from 1974 to 1996, a total of 42 cases of epidural abscess after epidural analgesia were reported.<sup>11</sup> This number probably represents a significant degree of underestimation of the problem. In this series, the incidence of epidural abscess after epidural analgesia was 1:1,930 catheters, which is higher than previously quoted estimates of approximately



1:5,000 catheters.<sup>5</sup> However, epidural abscess was associated with simultaneous occurrence of long duration of catheterization, possible immunosuppression, and low-dose anticoagulation in the large majority of patients.

Epidural abscess formation may occur spontaneously in approximately 1:10,000 hospital admissions in the United States.<sup>12</sup> We believe it to be unlikely that patients with previous epidural catheterization should develop a spontaneous abscess unrelated to the epidural catheter, because the abscesses in all patients were found at the same level as the previous catheter, and they occurred within a relatively short interval of the epidural catheter insertion.

Our results suggest that the use of thoracic *versus* lumbar epidural analgesia is similar. Epidural catheterization is performed after surgical hand wash, and the procedure includes wearing a hat, face mask, and sterile gloves, disinfecting the patient's skin twice with a chlorhexidine/70% alcohol solution (most often from a multiuse bottle), and using disposable epidural kits and drapes. When intraoperative epidural analgesia is used, it is likely to extend into the postoperative phase, and prolonged epidural catheterization ( $\geq 3$  days) is generally accepted for major general and orthopedic surgery in Denmark. Subsequently, segmental analgesia and segmental placement of the epidural catheter is the most commonly accepted procedure. This is further supported by the results of an international study of the use of spinal opioid analgesia in which 75% of the respondents preferred segmental analgesia for postoperative pain relief.<sup>13</sup> In accordance with this approach, we observed an 80% frequency of thoracic epidural catheterization at two university departments and a lower frequency at nonuniversity departments. Although these figures are the result of a subgroup analysis of 2,171 catheters, we believe that they are a reliable representation of the national anesthetic activity and of the use of segmental epidural analgesia. The distribution of the epidural abscesses presented here reflects the distribution of the epidural catheters, and our results do not support the assumption that thoracic epidural analgesia is more likely to result in symptomatic abscess formation than the lumbar approach. However, the absolute number of abscesses is, in this respect, low.

Eight of nine patients experienced uncomplicated catheter insertion. Therefore, our results do not support the anticipation that a technically difficult catheter insertion may predispose the patient to development of infectious complications. It has been suggested that mul-

iple needle insertions carry a risk of asymptomatic epidural hematoma formation that may later become the focus of bacterial colonization.<sup>11</sup> This remains undocumented, however, and hematogenous colonization of an epidural catheter is believed to be most unusual.<sup>14</sup> Two thirds of patients with epidural abscess received low-dose or low-molecular-weight heparin as thromboprophylaxis before epidural catheterization. Thromboprophylaxis for surgical patients has attracted much attention in Denmark. An analysis of periodic questionnaire surveys from 1981 to 1990 showed that 68% of all surgical departments had included regimens for thromboprophylaxis in departmental instructions.<sup>15</sup> This figure compares well to the finding of 66% of patients who received thromboprophylaxis in this study. However, our results cannot establish a cause-and-effect relationship between the use of low-molecular-weight heparin and the observed incidence of epidural abscess. Furthermore, our findings do not permit differentiation between an epidural abscess and an infected epidural hematoma, because MRI studies may be unable to distinguish the signals from a primary epidural abscess from those of a degrading hematoma with infection.

All patients in this study with spinal epidural abscess had epidural catheters *in situ* for  $\geq 3$  days, and there are still no reports of abscess formation in patients with short-term epidural analgesia ( $\leq 2$  days). Figure 1 illustrates that patients with epidural abscess had the catheter *in situ* three times longer than the mean catheterization time in 343 patients from one hospital (11.2 *vs.* 3.5 days). However, the figure also shows that in this group of 343 patients, most had the catheter *in situ* for 3 days, as was the case in one third of the patients with epidural abscess; therefore, although there are no reports of abscess formation after 2 days of catheterization, it seems that a catheterization time of 3 days does not eliminate the risk of epidural infection.

Patients in need of long-term epidural pain relief are by necessity severely ill. In our study, only one patient had no complicating disease, whereas four patients suffered from malignant disease, two had non-insulin-dependent diabetes mellitus, and two patients suffered from multiple trauma and chronic obstructive airways disease, respectively. This predominance of immunocompromised patients has also been found in previous studies.<sup>8,11,16</sup> Because long-term ( $\geq 3$  days) postoperative epidural pain relief most often is used after surgery for cancer, it is not surprising to find malignancy as a complicating disease in patients with epidural abscess. However, our

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findings do not permit the opposite conclusion, that epidural abscess is more likely to occur in patients with cancer than in patients without malignancy.

Seven patients underwent neurosurgery for evacuation of the abscess, and four were discharged with neurologic sequelae in the form of paraparesis of varying degrees. The patients who were treated with antibiotics only were discharged free of symptoms. The approach is in accordance with the results of Du Pen *et al.*,<sup>8</sup> who described successful antibiotic treatment of 15 nonsurgical patients with epidural infection after long-term epidural catheters in the absence of neurologic deficits. The overall outcome in patients with epidural abscess after prolonged epidural analgesia is grave, because 44% of these patients left the hospital with a persisting neurologic deficit. Larger studies of the outcome after epidural abscess after epidural analgesia have shown a similar incidence of neurologic deficits, and apparently no improvement in outcome has occurred since the period from 1947 to 1974.<sup>11</sup>

It is generally accepted that decompression of the spinal cord should be performed as soon as possible should signs of medullary affection occur.<sup>12,17</sup> In our study, there was a 6-day delay in the referral and neurosurgical treatment of patients. The outcome after epidural abscess is related to preoperative impairment,<sup>17</sup> which emphasizes the importance of vigilance and early diagnosis. It is therefore possible that the delayed recognition and intervention may have contributed to the high incidence of adverse outcomes in this series. One may speculate that there is a potential risk of delayed referral to neurosurgical departments of patients from nonuniversity hospitals. However, this was not demonstrated in the present study.

Signs of localized infection occurred in 67% of our patients, whereas 56% complained of back pain, and 56% had fever. One patient (11%) had symptoms and signs of meningitis, and neurologic deficits were found in 78%. Our results are in accordance with those of an analysis of patients admitted to a neurosurgical department with epidural abscess in which 10%, 62%, and 69% suffered from meningitis, fever, and neurologic deficits, respectively.<sup>17</sup> Therefore, the most common signs and symptoms of epidural abscess after epidural catheterization consist of neurologic deficits, elevated body temperature, and back pain, whereas meningitis is uncommon.

*S. aureus* was isolated in 67% of patients, which is in accordance with other reports.<sup>5,16,18,19,20,21</sup> All patients received antibiotic treatment, which is in line with

United States recommendations for treatment of spinal epidural abscess.<sup>17</sup> Two patients were treated with antibiotics only. It has been suggested that this treatment is acceptable in patients with a lumbar epidural abscess without neurologic symptoms in whom the causative bacteria is known.<sup>17</sup>

The findings of this study suggest that

1. the indications for epidural analgesia in the nine patients reflected those in the total population;
2. the patients with epidural abscess had a longer mean catheterization time than the population mean;
3. the majority of the patients with epidural abscess were immunocompromised by one or more complicating diseases;
4. the level of catheter insertion is not critical to the likelihood of abscess formation;
5. the long period from diagnosis of a postepidural spinal abscess to intervention may, in part, explain the severe outcome of these patients; and
6. the use of perioperative anticoagulant therapy was involved in most cases of epidural abscess, but the diagnostic neuroimaging techniques and the intraoperative neurosurgical findings did not verify the differential diagnosis of infected epidural hematomas.

There was a statistically significant difference in the frequency of epidural abscess at university *versus* community hospitals. However, the study design does not permit disclosure of interhospital differences in the indications and management of patients with epidural catheters, and further analysis of the reasons for the observed difference exceeds the scope of this study.

Epidural analgesia was used in 6% of all anesthetic procedures in Denmark. There is little doubt that epidural analgesia is a very effective method of pain treatment, and it is the responsibility of each anesthesiologist together with the patient to agree on the best and the most acceptable method of postoperative pain relief. It is hoped that the results of this study may assist the anesthesiologist in making that decision. A forthcoming national Danish database of all anesthetics given in the country may assist in the determination of the incidence of spinal epidural abscess after epidural catheters in relation to the catheterization period.

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## Appendix: Case Reports

### Case #1

A 70-yr-old man with a medical history of chronic obstructive airways disease and arterial hypertension was admitted for removal of a right-sided renal tumor with general anesthesia. Beginning the night before surgery, the patient received prophylactic low-molecular-weight heparin throughout the perioperative course. Immediately before induction of anesthesia, an epidural catheter was inserted at the T9/10 interspace. Intraoperative antibiotics were not used. Postoperatively, a second (new) catheter was inserted one level above because of insufficient analgesia from the initial epidural catheter. The catheter was used for postoperative analgesia for 3 days and was thereafter removed. Four days later the patient was febrile, the epidural site was inflamed, and after another 4 days a bilateral paraparesis was noted by the surgeon along with a sensory deficit distal to the upper abdomen. A computed tomography scan supplemented with a myelography revealed an epidural abscess at the T9/10 level. The patient was transferred to a neurosurgical department and underwent surgery immediately. *S. aureus* was isolated from the abscess, and antibiotic treatment with cephalosporine and aminoglycoside was commenced. Two months later the patient suffered from fecal and urinary incontinence and inability to stand, and was subsequently wheel-chair bound. The patient died 11 months after the neurosurgical procedure after several readmissions for bedsores.

### Case #2

A 73-yr-old man with a medical history of ischemic heart disease, severe chronic obstructive airways disease, and non-insulin-dependent diabetes mellitus was admitted for exchange operation of a previously inserted left-sided hip arthroplasty with epidural analgesia. Prophylactic low-molecular-weight heparin and dicloxacillin were administered. An epidural catheter was inserted at the L3/4 interspace and was left *in situ* for postoperative pain treatment. The catheter was removed on postoperative day 3. The postoperative course was complicated by severe respiratory worsening and a perforated gastric ulcer. On postoperative day 15, urinary retention was noted along with a persisting fever. Leukocyte scanning showed accumulation in the lumbar spine. Five days later, an MRI scan showed an epidural abscess at the L2 level, and the patient was transferred to a neurosurgical department 41 days after the epidural procedure and underwent surgery the same day. Preoperative blood cultures revealed the presence of *S. aureus*, and antibiotic treatment with meticillin and fusidic acid was commenced. The patient was discharged from neurosurgery with minimal motor deficits in the legs, with the right leg weaker than the left. At a 1-yr follow-up

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examination, the patient was unable to walk without crutches and suffered severe lumbar back pain.

### Case #3

A 55-yr-old man with a medical history of heavy smoking was admitted for resection of a lung tumor with general and epidural analgesia. The epidural catheter was inserted at the T4/5 level and was left for postoperative pain relief. Prophylactic low-molecular-weight heparin was not used, whereas a single dose of penicillin and gentamycin was given preoperatively. The catheter was removed after 6 days because of localized back pain. The patient was discharged from the hospital but was readmitted after another 6 days because of increasing back pain. The patient was examined by the anesthesiologist and was referred for MRI, which revealed an epidural abscess at the T1-T4 level. Later that day, the patient underwent decompressive laminectomy of the same spinal segments. Postoperatively, a minor bilateral lower-limb weakness was noted, and the patient was able to walk with crutches. Antibiotic treatment consisted of meticillin and fusidic acid for *S. aureus*.

### Case #4

A 74-yr-old woman with a medical history of non-insulin-dependent diabetes mellitus was admitted for insertion of a knee prosthesis with epidural analgesia. Prophylactic low-molecular-weight heparin was given on the night before surgery. The epidural catheter was inserted at the L3/4 interspace and left *in situ* for postoperative pain treatment during mobilization. Seven days postoperatively the patient complained of lumbar back pain, and over the following 9 days the pain worsened. Fever, local back pain at percussion, and cutaneous inflammation at the insertion site were noted. During the next 6 days the patient developed irradiating pain in both legs to the level of the ankles in addition to urinary retention. Blood cultures grew *S. aureus*. The patient was transferred to another hospital for MRI and subsequent neurosurgical decompression of an epidural abscess at the L2-L4 level. Antibiotic treatment consisted of cloxacillin and meticillin. The postoperative course was complicated by cardiac failure, pneumonia, and cystitis. Six days postoperatively a right leg paralysis was still observed, but the sphincter function was normal. The patient was readmitted to the neurosurgical department 11 days later for a presumed recurrent epidural abscess, but instead a diagnosis of pyelonephritis was made.

### Case #5

A 75-yr-old man with no complicating diseases was admitted for insertion of a knee prosthesis with epidural analgesia. The patient received prophylactic low-molecular-weight heparin starting on the night before surgery, and a single dose of dicloxacillin was given preoperatively. An epidural catheter was inserted in the L4/5 interspace and remained *in situ* for postoperative use during mobilization. Six days postoperatively the patient complained of back pain and fever. On examination the insertion site showed signs of inflammation, and pus was noted along the catheter. Moderate hip flexion weakness on the side of the operated leg was also found on examination. That day the patient underwent surgical debridement of a large subcutaneous abscess at the catheter insertion site. MRI was performed 2 days later, and a diagnosis of epidural abscess was made. The patient was transferred to another hospital for neurosurgical removal of the abscess at the L3 level. *S. aureus* was isolated from the catheter tip as well as

the abscess, and treatment with dicloxacillin was commenced. Postoperatively, no motor deficits were observed. One month later the patient was readmitted for neurosurgical revision of the subcutaneous cavity.

### Case #6

A 53-yr-old man with a medical history of dilated cardiomyopathy sustained a severe trauma with multiple rib fractures, lung contusion, fractures of right humerus and scapula, and hepatic contusion. The humerus fracture was treated with external fixation, and prophylactic dicloxacillin was given along with low-molecular-weight heparin. An epidural catheter was inserted at the T6/7 interspace for pain relief during weaning from ventilatory support. The patient was afebrile at the time of epidural catheterization. Because of fever and local signs of infection at the site of the epidural catheter, it was removed after 16 days. *S. aureus* was isolated from the catheter tip. During the following 4 days the patient developed bilateral paralysis of the legs and fecal incontinence. The patient was transferred to another hospital for MRI, which demonstrated an epidural abscess at the T3-T7 segments. Subsequent neurosurgical decompression of the spinal cord was performed the same day, but the paraparesis subsided only slowly. Five days postoperatively only minor hip and knee flexion was observed. Antibiotic treatment consisted of meticillin. The postoperative course was complicated by a total atelectasis of the left lung, necessitating a further period of positive pressure ventilation.

### Case #7

A 48-yr-old woman with breast cancer with dissemination to the lungs, liver, and the lumbar spine, for which she received repeated chemotherapy, underwent epidural catheter insertion at the T7/8 interspace for long-term treatment of cancer pain. Sixteen days later the patient complained of pain at injection site, weakness of the right leg, and paresthesiae. Over the next 5 days two doses of epidural steroid were administered, and the catheter was removed on day 31. After another 9 days (day 40), inspection of the catheter site showed inflammation and frank pus, and the patient developed signs of meningitis (fever, meningismus, headache). There were no neurologic deficits, but the backache increased over the following 8 days. An MRI performed on day 48 showed an epidural abscess extending from T5 to T11. *S. epidermidis* was isolated from the catheter tip and as well as from the pus, and antibiotic treatment consisted of dicloxacillin, penicillin, and gentamycin. After neurosurgical review, surgery was deferred because of a lack of neurologic deficits. A follow-up examination 2 months later showed no residual signs of infection and no neurologic deficits.

### Case #8

A 71-yr-old woman with previous good health was admitted for a left-sided hemicolectomy for cancer with general and epidural anesthesia. Low-molecular-weight heparin and antibiotics were administered prophylactically. The epidural catheter was inserted at the T8/9 interspace and was left *in situ* postoperatively for pain relief. On the fourth postoperative day the patient complained of weakness of the left leg. On inspection, no signs of local inflammation at the catheter insertion site were noted. An MRI scan showed a posterior epidural collection at the T7/8 level without displacement of the spinal cord. Computed tomography scan of the brain was normal. No bacteria were



isolated, but antibiotic treatment with ampicillin, cefuroxime, and gentamycin was commenced.

#### *Case #9*

An 80-yr-old man with a medical history of bladder cancer, for which he had undergone radiation therapy and transurethral resection of the prostate on several occasions, received sulphamethiazole for asymptomatic urinary tract infection. An epidural catheter was inserted at the L2/3 interspace for long-term pain relief. Three weeks later the patient developed lumbar back pain and increasing irradiating pain in the lateral left femur along with altered perception in the same dermatome. The patient

was readmitted after another 4 days with increasing pain. No systemic or local signs of infection were observed; however, an MRI scan performed at a different hospital on the following day showed an epidural abscess situated to the left of the L2 vertebra. Subsequent neurosurgical decompression of the spinal cord was performed on the same day. The neurologic signs normalized, but the postoperative course was complicated by signs of gastrointestinal perforation. Because of old age, the patient was treated conservatively with nasogastric decompression of the gut, intravenous omeprazole, and broad spectrum antibiotics, and he recovered slowly. Complications of the previous radiation therapy were suspected as the underlying cause.