

# Continuous spinal anesthesia for lower limb surgery: a retrospective analysis of 1212 cases

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**Background:** Continuous spinal anesthesia is a very reliable and versatile technique for providing effective anesthesia and analgesia. However, the incidence of possible complications, including postdural puncture headache or neurological impairment, remains controversial. Therefore, the aim of the present retrospective study was to analyze a large number of patients for the incidence of adverse events after continuous spinal anesthesia with a microcatheter.

**Methods:** This retrospective study was conducted on 1212 patients who underwent surgery of the lower extremities with continuous spinal anesthesia, which was administered with 22-gauge Quincke spinal needles and 28-gauge microcatheters. Sociodemographic and clinical data were available from the patient records, and data on headaches and patient satisfaction were drawn from a brief postoperative patient questionnaire.

**Results:** The patient population included 825 females (68%) and 387 males; the median age was 61 (56–76). The types of operations performed were 843 hip prostheses, 264 knee prostheses, and 105 other leg operations. No major complications were observed in any of these patients. Tension headaches were experienced by 190 (15.7%) patients, but postdural puncture headaches were reported by only 18 (1.5%) patients. Nearly all patients (98.4%) were satisfied with continuous spinal anesthesia and confirmed that they would choose this kind of anesthesia again.

**Conclusion:** Based on the findings of this large data analysis, continuous spinal anesthesia using a 28-gauge microcatheter appears to be a safe and appropriate anesthetic technique in lower leg surgery for aged patients.

**Keywords:** continuous spinal anesthesia, microcatheter, complications, postdural puncture headache

## Introduction

Continuous spinal anesthesia (CSA) is a longstanding anesthetic technique for surgery of the lower limbs and lower abdomen. The technique for realizing continuous spinal anesthesia is different – in our study we accessed the subarachnoid space with a 22-gauge needle and passed the catheter through the needle. There is a different technique, in which the subarachnoid space is accessed with a 27-gauge or 29-gauge needle and the catheter is shifted over the needle (Spinocath<sup>®</sup>, B. Braun, Melsungen, Germany). These techniques have different results. CSA has several advantages over a single-dose spinal anesthesia and continuous epidural anesthesia: (1) administration of local anesthetics in small incremental doses titrated to the individual patient's needs; (2) reduced requirements of local anesthetics and thus decreased systemic toxic effects; (3) ensured cardiovascular stability; and (4) extended anesthesia by supplemental application of spinal local analgesics when surgery is unexpectedly extended.<sup>1–3</sup>

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Although CSA with large needles and catheters was associated with a high incidence of postdural puncture headache (PDPH), it is now well accepted that PDPH is due to leakage of cerebrospinal fluid through the dural puncture and to the size of the needle used.<sup>1,4-6</sup> Thus, the development of microcatheters (28-gauge to 32-gauge) has significantly reduced the incidence of this complication.<sup>1,4,7,8</sup>

Unfortunately, the use of microcatheters was discontinued in the USA<sup>9</sup> and Australia following case reports of cauda equina syndrome,<sup>10</sup> based mainly on the results of case studies or small studies. However, case reports are considered level-4 evidence, and up to now, there is a lack of evidence from larger studies about microcatheter-related adverse events, including neurological deficits and motor impairment. Moreover, there is ample evidence that the cauda equina syndrome was not caused by the microcatheter itself but instead by high concentrations of local anesthetics,<sup>2,7,10,11</sup> maldistribution of local anesthetics,<sup>10,12-14</sup> and/or the inexperience of the anesthesiologists.<sup>14,15</sup> Furthermore, several authors have made recommendations to improve the technique of placing the microcatheter or Spinocath<sup>®</sup> and to ensure safety.<sup>1,3,5,7,8,10,12-22</sup> Thus, CSA is still widely used in Europe for surgery of the lower limbs and hypogastric region, and the use of microcatheters and Spinocath<sup>®</sup> still seems to be the best approach in avoiding PDPH.

Only six larger ( $n \geq 100$ ) studies on CSA with microcatheters<sup>6,7,17,18</sup> and Spinocath<sup>®</sup><sup>19,21</sup> investigated the feasibility and safety of CSA. Three of them<sup>6,7,19</sup> ( $n = 332$ ,  $n = 100$ ,  $n = 117$ , respectively) reported low PDPH rates of 1.5%, 1.0%, and 1.7%, respectively. None of these three studies reported severe complications, and they all concluded that this technique was safe and feasible. Two studies about the efficacy of CSA for labor analgesia<sup>17,21</sup> ( $n = 127$ ,  $n = 329$ , respectively) reported high PDPH rates of 33.1% and 9%, respectively, possibly due to the younger age of the women and the insertion of larger catheters. The only major complication was one case (0.8%) of paresthesia, which resolved entirely by the fourth postoperative day.<sup>17</sup> PDPH is age-related – one study with only geriatric patients ( $n = 154$ ) reported no cases of PDPH or other neurologic complications.<sup>18</sup>

The aim of the present analysis was to evaluate the safety of CSA with microcatheters in a large patient population. This study focused on the incidence of neurologic complications such as PDPH, cauda equina syndrome, and other persistent neurological deficiencies.

## Methods

### Patients

After approval by the regional ethical committee, the medical records of all patients undergoing CSA with a 22-gauge Quincke needle and a 28-gauge microcatheter during the past 6 years were reviewed. At this hospital, all patients (ASA I-III) undergoing surgery for allogenic joint replacement of the knee or hip, or undergoing arthroscopic surgery of the knee joint, received CSA via a 28-gauge microcatheter. Contraindications for CSA were lack of patient compliance, pathological coagulation (Quicktest  $< 50\%$ , PTT  $> 50$  sec, platelets  $< 50,000$  gigaparticles/L), local infection in the puncture area, and severe deformity of the spinal column. The patients were informed about potential complications, and written informed consent for anesthesia was obtained from each patient. Patients were provided with a questionnaire about the anesthesia on the third postoperative day. This questionnaire was the quality-assurance tool for all patients undergoing anesthesia; it was individually administered and received by anesthesiologists or pain nurses. All patients were examined for neurological impairment before leaving the hospital. There were 97 patients (7.4%) who were not included in this analysis due to failure of microcatheter placement or lack of analgesia. Other data, such as dose-dependent spreading of regional anesthesia, onset time of anesthesia, or pain scores, were not similar or were not systematically documented. These were limitations of our retrospective study.

This study included 1212 patients in whom operations were carried out under CSA with a microcatheter.

### Devices

The needles and microcatheters used in this study were from the Cospan Kit (Kendall Inc, Neustadt, Germany). This kit included a 22-gauge Quincke needle and a 28-gauge microcatheter.

### Clinical procedure

In the evening prior to surgery and on the morning of the day of surgery, patients received 50 mg of dikaliunclorazepat (Sanofi-Winthrop, Kent, UK) for premedication.

After establishing a venous access, CSA was conducted under ECG monitoring with the patient in a sitting position. The choice of median or lateral access for spinal puncture at L3/4 or L4/5 was made by the anesthesiologist and depended on the anatomy of the patient. The dura was punctured with the cutting surface in a lateral direction. Prior to the insertion

of the catheter, the opening of the needle was turned in a cranial direction. The spinal catheter was advanced 2–4 cm into the intrathecal space and was fixed by sterile tape. The cerebrospinal fluid was aspirated, and subsequently 0.5 mL bupivacaine 0.5% hyperbar, to a maximum of 2.5 mL, was injected while the patient was in a horizontal position with the upper body slightly elevated. The total dose was dependent on the spreading effect of anesthesia. Single doses of 1.0 mL bupivacaine 0.5% isobar were injected intraoperatively if necessary.

Postoperatively, all patients were transferred to an intermediate care unit for routine postoperative surveillance until the next day. Subsequently, patients were visited daily by an anesthesiologist. CSA with 1.6–2.2 mL/hour bupivacaine 0.08% isobaric was established for at least 24 hours after surgery, and the spinal catheter was removed on the second day after surgery with the patient in a sitting position. Patients experiencing headache were examined clinically to determine the kind of headache (tension, postdural puncture, etc), whereby headaches that increased in intensity upon rising to a standing or sitting position, or upon coughing, were classified as PDPH. Patients with typical PDPH (aggravated pain upon standing up from a supine position) received a nonsteroidal anti-inflammatory drug and 500 mL crystalloid infusions in 8-hour intervals. If this treatment was not successful, the patient's permission was sought for the application of a blood patch with 10 mL of autologous blood near the site of primary puncture to the epidural space. Patients with blood patches were monitored for at least 4 more days in the hospital in order to detect possible delayed complications.

## Data and statistics

Three anesthesiologists (the author was one of them) performed all CSAs included in this study and reported patient data and procedure-specific data about the anesthesia procedure, intraoperative sedation, and duration of surgery. Furthermore, patients were provided with a questionnaire about the anesthesia on the third postoperative day by the anesthesiologists or pain nurses. The questionnaire consisted of six yes/no questions, including four questions about the existence of their objective symptoms (pain during surgery, vomiting after the operation, complaints lasting more the 24 hours postoperatively, and postoperative headaches) and two questions about the patient's satisfaction with the anesthesia during the operations (specifically, the patient's expectations and whether the patient would choose the anesthesia again). Questionnaires were completed by all of our patients.

Descriptive statistics were used to characterize the patient population and to report the clinical outcome and patient satisfaction. Statistical analyses were performed with Stats4U, version 1.6. 3 (William G Miller, Ankeny, IA).

## Results

### Patients

The patient population included 825 females (68%) and 387 (32%) males. The patients had a median (IQR) age of 61 years (56–76), with a range of 28–90 years. The types of operations performed were 843 hip prostheses, 264 knee prostheses, and 105 other operations on the lower extremities.

### Neurological impairment

None of the 1212 patients included in this analysis reported any forms of neurological deficits or motor impairment after the removal of the spinal microcatheter. Serious adverse events, such as death, life-threatening complications, event-dependent prolongation of hospitalization, or persistent handicaps, were not observed.

### Headaches

Tension headaches were experienced by 190 (15.7%) patients, of whom 27 received therapy (2.2%). Postpuncture headaches were experienced by only 18 (1.5%) patients. Therapeutic intervention consisting of bed rest, infusions of crystalloids, or application of nonsteroidal anti-inflammatory drugs on two days failed to produce lasting effects in the patients reporting typical postdural puncture headache. Therefore, all of these patients received a blood patch and were immediately pain free.

### Patient satisfaction

Of the patients included, 1193 (98.4%) would have chosen the same anesthesia technique again if they were to undergo a similar procedure of the lower extremities.

### Minor complications

In 102 cases (8.4%), anesthesiologists reported paresthesia in the lower extremities in the moment of placing the microcatheter, but no patient had persistent neurological impairments. Forty-nine catheters had to be removed in the first 24 hours because of technical problems, including breaking or disconnection of the microcatheter.

## Discussion

CSA provides a number of potential advantages over other forms of anesthesia,<sup>1–3</sup> including hemodynamic stability

and extended analgesia.<sup>20,23,24</sup> But some anesthesiologists are not permitted to use microcatheters, due to government concern over the risk of cauda equina syndrome, and others have remained reluctant to perform CSA, even with microcatheters, because of uncertainty about the incidence of PDPH.

The present retrospective study was performed on all patients receiving CSA and undergoing surgery at the hospital – either allogenic joint replacement of the knee or hip or arthroscopic surgery of the knee joint.

In the present analysis of 1212 patients, no case of cauda equina syndrome or any other major neurologic complications were observed. Hopwood has estimated that in order to define the incidence of CSA (with microcatheters) inducing adverse neurologic events, including cauda equina syndrome, a prospective study with a minimum sample size of about 3300 to 5700 patients, depending on the accepted level of statistical uncertainty (beta error), is necessary.<sup>25</sup> Thus, the results of our survey (n = 1212), together with the cumulative population of patients with CSA included from other smaller studies (n = 568, approximately)<sup>6,7,17,18</sup> may reveal enough evidence to demonstrate that CSA with a 28-gauge microcatheter will not cause an increased risk for cauda equina syndrome compared to other anesthetic procedures.

The use of smaller needles and microcatheters decreases the rate of PDPH in CSA in comparison to larger puncture needles. The PDPH rate of 1.5% found in our study is consistent with several other studies<sup>6,7</sup> and represents an acceptable level of risk.<sup>16</sup> Kumar et al<sup>20</sup> reported 5.6% PDPH in 68 elderly patients, 65–82 years old. Döhler et al<sup>18</sup> observed no cases of PDPH in 154 patients, aged over 70 years (mean 82.3 years). Importantly, obstetric patients are at higher risk of PDPH than the general population, probably due to the younger age of the patients.<sup>21,23,24</sup>

If patients had PDPH, we treated them with bed rest, infusions of crystalloids, and applications of nonsteroidal anti-inflammatory drugs on 2 days. In cases of failed lasting effects in patients reporting typical postdural puncture headache, the patients received a blood patch and were immediately pain free. This method is recommended in the literature, with response rates to blood patches being about 90%.<sup>26</sup>

Nearly all (98.4%) patients in this study reported in our questionnaire that they would choose this kind of anesthesia again. Besides simply showing patient satisfaction, this finding is an inverse, patient-centered way of investigating complications. It showed that 98.4% of the patients did not

experience any complications from the anesthetic technique that concerned them enough to dissuade them from accepting CSA again.

The advantages and disadvantages of regional anesthesia at the lumbar spine are compared by Kumar et al.<sup>20</sup> With the CSA catheter, the space location is definite, and the correct position can be checked by aspiration of liquor. The onset of the bloc is fast, titration is possible, and systemic toxicity is low.<sup>20</sup> However, physicians in Germany do not commonly use CSA. The puncture of the intrathecal space is mostly simple, but the handling of microcatheters or Spinocath® needs getting used to. Successful puncture of the spinal space does not mean a successful positioning of the microcatheter; aspiration of cerebral fluid takes a longer time. In clinical practice, spinal catheters can be mistaken for epidural catheters. In addition, microcatheters are expensive.

In the present large study of patients undergoing orthopedic surgery and receiving CSA with a microcatheter, no major neurologic complications, including cauda equina syndrome, were observed. The incidence of PDPH was acceptably low, so the potential benefit of better hemodynamic stability and extended analgesia can outweigh concerns over PDPH.

In conclusion, we find that CSA with a 28-gauge microcatheter is a feasible and advantageous approach to anesthesia for aged patients undergoing lower limb surgery.

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## Disclosure

The author reports no conflicts of interest.

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