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Comparative Analysis of Spinal Anaesthesia and Epidural Anaesthesia for Caesarean Section: Impact on Postoperative Analgesic Consumption and Pain Management

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Abstract

Background and Objective: Regional anesthesia is commonly used for elective caesarean sections. This study aimed to assess the impact of spinal anesthesia versus epidural anesthesia on postoperative analgesic consumption and pain relief in women undergoing elective caesarean section.

Methods: A comparative analysis of spinal and epidural induction of perispinal anesthesia was conducted in 132 women (ASA I or II) scheduled for elective caesarean section, all of whom underwent epidural catheterization for perioperative anesthesia and postoperative analgesia. Patients were randomly assigned to two groups: spinal anesthesia with isobaric bupivacaine 0.5% and 5 µg sufentanil intrathecally or epidural anesthesia with ropivacaine 0.75% and 10 µg sufentanil. Postoperative analgesia was managed using patient-controlled epidural analgesia with ropivacaine 0.133% bolus (11–15 mg based on patient's height) and a lock-out time of 1 hour. Pain scores and analgesic requirements were assessed intraoperatively and for 24 hours post-surgery using visual analogue pain scales.

Results: One hundred and twenty-five patients completed the study. There were no significant differences in patient-controlled epidural analgesic requirements between the spinal and epidural anesthesia groups. Intraoperative pain scores were higher with epidural anesthesia ($P < 0.05$). However, the overall area under the curve for pain over 24 hours was lower with spinal anesthesia ($P < 0.0005$). Postoperative pain scores at rest and during mobilization were consistently lower with spinal anesthesia ($P < 0.05$), accompanied by less motor blockade and fewer adverse effects. More patients in the epidural anesthesia group required supplemental analgesics.

Conclusion: For elective caesarean sections, postoperative epidural analgesia via patient-controlled epidural analgesia is comparable between spinal and epidural anesthesia. Spinal anesthesia, however, results in less postoperative pain, reduced need for additional analgesics, and fewer side effects.

Introduction

Caesarean section is a prevalent surgical procedure globally, with significant variations in rates across countries such as the United States and Germany. Regional anesthesia has become the preferred choice over general anesthesia for caesarean sections due to lower maternal morbidity and mortality risks. Both spinal anesthesia and epidural anesthesia (EDA) are effective options for providing anesthesia during caesarean sections, with a growing preference for spinal anesthesia in elective cases due to its perceived advantages in simplicity and block density. (Stamer et al., 2005)

While many studies have compared the intraoperative pain management of spinal anesthesia versus EDA, there is a gap in understanding their effects on postoperative pain. Preemptive analgesia, a concept aiming

to reduce postoperative pain amplification by initiating effective analgesia before surgery, has sparked interest in exploring the postoperative pain outcomes of different regional anesthesia techniques. Experimental evidence suggests that spinal anesthesia may have a stronger preemptive effect by suppressing central sensitization compared to EDA. However, clinical studies on preemptive analgesia's efficacy have yielded mixed results. (Ng et al., 2004)

We hypothesized that the superior intraoperative pain relief provided by spinal anesthesia would translate into reduced postoperative pain and lower analgesic requirements compared to EDA. To test this hypothesis, we conducted a prospective randomized study among women undergoing elective caesarean sections, evaluating the impact of spinal anesthesia or EDA on postoperative analgesic needs using patient-controlled epidural ropivacaine administration. (Capogna et al., 2003)

Methods

The study included 132 parturients at full term, with ASA I or II status, following approval from the Ethics Committee and obtaining informed consent. Exclusions comprised individuals under 18 years, those with known allergies to local anesthetics, a tendency for bleeding, or an inability to comprehend patient-controlled epidural analgesia (PCEA). These participants were randomly assigned to either the epidural anesthesia (EDA) or spinal anesthesia groups.

During the interventions, prior to the block, patients received a 500 ml hydroxyethyl-starch infusion, and the use of vasoconstrictive medication post-neuraxial block was at the discretion of the attending anesthesiologist. The block technique varied between groups, with the EDA group receiving ropivacaine 0.75% and sufentanil, while the spinal anesthesia group received isobaric bupivacaine 0.5% and sufentanil. The onset of surgery followed the achievement of a T6 sensory block using the Misgav–Ladach technique for caesarean section.

Post-operatively, all participants were managed with patient-controlled epidural analgesia (PCEA) using ropivacaine 0.133%, with lock-out periods based on patient height. Supplementary analgesia with rectal diclofenac was available if needed. Pain assessment using visual analogue scales (VAS) was conducted at various intervals, along with monitoring for side-effects and sedation levels. Statistical analysis, including Mann–Whitney rank sum, chi-squared, or Student's t-test, was performed, with significance set at $P < 0.05$. The area under the curve (AUC) was calculated to assess pain over a 24-hour period.

The study's sample size and power calculation aimed for sufficient statistical power, with a target of 61 patients in each group. This calculation was based on a pilot study and aimed to detect a specific difference in local anesthetic consumption between the groups. Overall, the study design and statistical approach were structured to rigorously evaluate the effects of spinal anesthesia versus epidural anesthesia on post-operative analgesia and pain outcomes in parturients undergoing elective caesarean section.

Results

One hundred and thirty-two patients were initially included in the study, with seven subsequently excluded (reasons detailed in the study's figure). Sixty-three patients were in the EDA group, and 62 were in the spinal anesthesia group, completing the study for statistical analysis. Patients' characteristics were similar between the groups, with more women in the spinal anesthesia group having prior central neuraxial blocks for labor analgesia or other surgeries. The onset of sensory block was faster in the spinal anesthesia group, but time to delivery and total surgery duration were comparable between the groups. During surgery, no additional intravenous analgesia was required, although patients with EDA reported higher pain scores on the visual analogue scale (VAS).

Consumption of ropivacaine via PCEA was similar between groups, but more EDA patients required supplemental analgesic medication, leading to a higher overall dose of rectal diclofenac. The AUC of VAS scores at rest and during mobilization and coughing over 24 hours was significantly higher in the EDA group compared to the spinal anesthesia group. At various time points postoperatively, EDA patients had higher pain scores compared to spinal anesthesia patients, except immediately and 3 hours after surgery.

There were no instances of bradycardia, and both groups remained hemodynamically stable throughout the procedures. Motor weakness (Bromage grade 1 or above) was significantly lower in the spinal anesthesia group except at 24 hours post-surgery. Pruritus was the most common adverse effect in both groups, with more cases in the spinal anesthesia group but without treatment requests. EDA patients experienced more vertigo and backache at different time points, with backache incidence increasing over 24 hours. Headache rates were similar, with no cases of postdural puncture headache within 24 hours. Sedation, nausea, and vomiting rates were low in both groups, with slightly more nausea in the EDA group, though not statistically significant. Neonatal outcomes were comparable across groups.

Discussion

The research aimed to compare the effects of spinal anesthesia and epidural anesthesia (EDA) on postoperative analgesic needs in women undergoing elective cesarean sections. The study enrolled 132 parturients with uncomplicated pregnancies, randomly assigning them to either the spinal anesthesia or EDA group. (Stamer et al., 2005)

Both spinal anesthesia and EDA are commonly used for elective cesarean sections, providing effective intraoperative anesthesia. However, postoperative analgesia remains a challenge for many patients. Experimental studies suggest that the quality of intraoperative anesthesia can impact postoperative analgesia, with spinal anesthesia potentially offering superior preemptive analgesic effects due to its mechanism of action. However, clinical studies have yielded conflicting results regarding preemptive analgesia's impact on postoperative pain. (Melzack et al., 2001)

The primary endpoint of the study, measuring local analgesic consumption via patient-controlled epidural analgesia (PCEA), did not show significant differences between the groups. However, secondary endpoints revealed that women with spinal anesthesia experienced lower postoperative pain scores and required less supplemental analgesic medication like diclofenac compared to those with EDA. These findings suggest that spinal anesthesia may offer better intraoperative and postoperative pain relief. (Altman et al., 2001)

The study's protocol involved combining local anesthetics with sufentanil for both spinal anesthesia and EDA. While such combinations are common in cesarean sections, there is limited data on the comparative effectiveness of different opiate agents via different routes of administration. The study's results may have been influenced by the chosen doses and volume of medications used. (Rawal, 2002)

Safety concerns with PCEA include potential complications like catheter displacement or respiratory depression from opiates. To mitigate risks, the study protocol excluded background infusion and limited ropivacaine boluses. Despite these precautions, some patients experienced breakthrough pain, especially during the night, indicating potential benefits from a background infusion or low-dose opiates in PCEA. (Capogna et al., 2003)

In conclusion, both spinal anesthesia and EDA are viable options for elective cesarean sections. However, spinal anesthesia provided better intraoperative and postoperative pain relief in this study. Further research may explore optimizing PCEA protocols to enhance postoperative analgesia while minimizing side effects and complications.

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