



# Revista Colombiana de Anestesiología

## Colombian Journal of Anesthesiology

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### Essay

## Regional versus general anesthesia for cesarean section delivery<sup>☆</sup>

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#### ARTICLE INFO

##### Article history:

Received 16 January 2012

Accepted 1 May 2012

##### Keywords:

Cesarean section  
General anesthesia  
Spinal anesthesia  
Epidural anesthesia

#### ABSTRACT

**Introduction:** There is no standard anesthesia technique for cesarean section. General anesthesia has been associated with higher morbidity–mortality; however, recent studies seem to disagree with such statement.

**Objective:** Based on a search in the literature, to reflect on the comparative results of regional vs. general anesthesia for C-section considering three aspects: mortality, morbidity and neonatal outcomes.

**Methods:** Article for reflection. A non-systematic search of the literature on the topic was performed in the Medline/Pubmed, Embase, Cochrane and Lilacs databases, using Mesh terms included in the key words.

**Results:** Although the rates for cesarean sections have been constant, the use of general anesthesia has decreased progressively. Maternal mortality associated to general anesthesia during cesarean section has dropped to practically the same level as regional anesthesia: 1.7 (95% CI, 0.6–4.6). Mortality is lower with regional anesthesia: less bleeding, lower risk of surgical site infection, less post-operative pain. The neonatal outcomes are practically the same.

**Conclusion:** As long as they are not contraindicated, neuraxial anesthetic techniques are the method of choice for C-section delivery, because they are associated with lower morbidity, though mortality and neonatal outcomes are similar as compared to general anesthesia.

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#### Anestesia regional versus general para parto por cesárea

#### RESUMEN

**Introducción:** No existe una técnica estándar de anestesia para el parto por cesárea. La anestesia general ha sido asociada con mayor morbimortalidad; sin embargo, estudios recientes parecen no estar de acuerdo con esta afirmación.

##### Palabras clave:

Cesárea  
Anestesia general

<sup>☆</sup> Please cite this article as: Páez L. JJ, Navarro V. JR. Anestesia regional versus general para parto por cesárea. Rev Colomb Anesthesiol. 2012;40:203–6.

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Anestesia raquídea  
Anestesia epidural

**Objetivo:** Hacer una reflexión a través de los resultados de estudios que comparan anestesia regional y general para cesárea desde 3 aspectos: mortalidad, morbilidad y desenlaces neonatales, a partir de una búsqueda de la literatura

**Métodos:** Artículo de reflexión. Se realizó una búsqueda no sistemática de la literatura referente a este tema en las bases de datos Medline/Pubmed, Embase, Cochrane y Lilacs usando términos Mesh incluidos en las palabras clave.

**Resultados:** Aunque la tasa de cesáreas se ha mantenido constante, el uso de anestesia general ha disminuido progresivamente. La mortalidad materna asociada a anestesia general durante cesárea ha descendido hasta prácticamente ser igual a la de anestesia regional (1,7 (CI 95%, 0,6–4,6)). La morbilidad es menor con anestesia regional: menor sangrado, menor riesgo de infección del sitio operatorio y menor dolor posoperatorio. Los desenlaces neonatales son prácticamente iguales.

**Conclusión:** Las técnicas de anestesia neuroaxial son la elección para parto por cesárea siempre que no esté contraindicada, porque se asocia con menor morbilidad, aunque la mortalidad y los desenlaces neonatales son similares cuando se compara con anestesia general.

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## Introduction

In 1999 a review article was published in the journal that evaluated the available evidence on the use of regional versus general anesthesia for cesarean section delivery.<sup>1</sup> The findings indicated that general anesthesia was associated with higher morbidity–mortality. Since then, several randomized trials and meta-analysis have been published denying that statement. The objective of this article is reflect on the results of trials comparing regional versus general anesthesia for cesarean section from three aspects: mortality, morbidity and neonatal outcomes.

## General observations

C-section is performed in 30% of live births and is the most usual surgical procedure in the United States;<sup>2</sup> In Colombia, the percentage of deliveries through c-section is quite similar (25–30%).<sup>3</sup>

Neuraxial anesthesia techniques are currently most widely used for cesarean section surgery and they are even used in situations that used to be considered an indication for general anesthesia (cord prolapse, preeclampsia, placenta previa).<sup>4,5</sup> In the United States the use of neuraxial anesthesia has been increasing since 1980s, particularly subarachnoid anesthesia (80% of C-sections are done under neuraxial anesthesia).<sup>5</sup> A retrospective study from a third tier hospital in the United Kingdom<sup>6</sup> found that despite a constant rate of cesarean sections (23.1–30%), the use of general anesthesia has dropped considerably (0.8% of all C-sections).

The rise in epidural anesthesia during labor, the use of mixtures of local anesthetic and opiates and the desire to avoid fetal exposure to depressant medications and to allow the mother to remain awake during delivery have been instrumental to these changes.<sup>4</sup>

## Mortality

Randomized clinical trials and meta-analyses have been unable to prove that any of the techniques is associated to increased mortality.<sup>7</sup> Hawkins et al.<sup>8</sup> published a preliminary study in 1997, analyzing all anesthesia-related maternal deaths between 1979 and 1990; they found 129 anesthesia-related maternal deaths; 67 under general anesthesia and 33 with neuraxial anesthesia. The relative risk of maternal death during general anesthesia was 2.3 (CI 95% 1.9–2.9) for 1974–1984 and 16.7 (CI 95% 12.9–21.8) from 1985 to 1990. Probably these patients exhibited more critical clinical conditions. A second trial in 2011,<sup>9</sup> identifying anesthesia-related maternal deaths from 1979 to 2002, 86 anesthesia-related maternal deaths were found from 1991 through 2001. The ratio of maternal death associated with anesthesia was 2.9 per million live births from 1979 to 1990 and 1.2 per million live births from 1991 to 2002, a 59% decrease. The relative risk of anesthesia-related maternal death dropped to 1.7 (95% CI 0.6–4.6 [non-significant]) from 1997 to 2002. Probably these findings reflect an improvement in the general anesthesia techniques; implementation of algorithms for managing the difficult airway and prevention of pulmonary aspirate; and increased use of regional anesthesia for high-risk C-section patients.

## Morbidity

### Bleeding

One trial in Thailand found a lower post-operative hematocrit associated with anesthesia as compared to epidural or subarachnoid anesthesia for cesarean section.<sup>10</sup> Two clinical trials<sup>11,12</sup> and one meta-analysis<sup>7</sup> found that intraoperative bleeding was less with epidural anesthesia (–126 mL)

and with spinal anesthesia (−0.59 mL) than with general anesthesia. Although these data are statistically relevant, their clinical significance must be evaluated, keeping in mind that the average bleeding in a cesarean section is 500–1000 mL.

### **Surgical wound infection**

In Cochrane's meta-analysis no studies reporting surgical wound infections were found;<sup>7</sup> however, a retrospective study was recently published with an OR finding for surgical site infection within the 30 days after general anesthesia versus neuraxial anesthesia cesarean section of 3.73 [95% CI 2.07–4.53].<sup>13</sup>

### **Pain**

Pain perception during the C-section intraoperative period is more severe in patients under regional anesthesia;<sup>10</sup> however, postoperative pain is less in patients with neuraxial techniques, since the time for the first boost of analgesia is longer (690 min versus 190 min in the general anesthesia group)<sup>11</sup> and the VAS scores for pain are lower (54 mm vs. 72 mm,  $p < 0.001$ ).<sup>12</sup>

### **Nausea and vomiting**

Nausea is more frequent in epidural anesthesia (OR 3.17 [95% CI 1.64–6.12]) and in spinal anesthesia (OR 23.2 [95% CI 8.69–62.30]), while vomiting is more frequent only in the spinal anesthesia group of patients (OR 7.05 [95% CI 3.06–16.23]), when compared against general anesthesia.<sup>6,9</sup> A more recent study found no differences.<sup>14</sup>

### **Patient satisfaction**

Lertakyamanee found no differences in terms of patient satisfaction when comparing spinal, epidural or general anesthesia patients.<sup>10</sup> In contrast, Fassoulaki measured patient satisfaction using the VAS and found higher scores among the neuraxial anesthesia patients (77 versus 52 with general anesthesia,  $p = 0.001$ ).<sup>14</sup> 81% preferred neuraxial anesthesia for a third C-section.

### **Other outcomes**

The percentage of patients who walked during the first 24 h was higher in neuraxial anesthesia patients (51% versus 29%,  $p = 0.003$ ) and the percentage of mothers who saw their baby during the first post-op day was also higher (98% versus 51% in the general anesthesia group,  $p < 0.001$ ).<sup>14</sup>

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## **Neonatal outcomes**

### **Umbilical arterial and venous pH**

These trials have been contradictory. Sener et al., published in 2003 a study that randomized 30 patients to general or epidural anesthesia for C-section;<sup>15</sup> the umbilical vein pH

and arterial PO<sub>2</sub> arterial were higher in the epidural anesthesia group ( $p < 0.05$  and  $p < 0.001$ , respectively). In Cochrane's<sup>7</sup> meta-analyses, 8 studies found no difference in the umbilical arterial pH, when the indication for C-section was not an emergency. Three trials<sup>12,16,17</sup> have found that the umbilical artery pH was significantly lower in neuraxial anesthesia patients as compared to general anesthesia. A recent study found no differences in the umbilical artery pH values.<sup>18</sup>

In contrast, the umbilical vein pH has been found to be constantly higher in patients receiving regional anesthesia, as compared against general anesthesia.<sup>7,19,20</sup>

### **Neurological adaptation scores**

No differences were found in the neurological adaptive capacity at 2 and 4 h of newborn life from mother who underwent general or epidural anesthesia C-section.<sup>7,15,20</sup>

### **Apgar score**

Two studies reported 1-min Apgar scores that were significantly lower in children from mothers who underwent general anesthesia C-section, as compared against epidural anesthesia.<sup>7,19,20</sup> However, there were no differences with subarachnoid anesthesia. The trend is similar at 5 min. Korkmas in 2004,<sup>21</sup> found no differences in the 1-min and 5-min Apgar scores, when comparing epidural – spinal anesthesia versus general anesthesia.

When considering the neonates with Apgar scores less than 4 or 6 at 1 and 5 min, the proportion receiving general anesthesia is no different from those receiving regional anesthesia.<sup>7</sup>

In the study by Mancuso et al.<sup>18</sup> the percentage of neonates with Apgar scores less than 7 at 1 min was 25.9% for the general anesthesia group and 1.1% for the spinal anesthesia group ( $p < 0.001$ ); however, after 5 min, all neonates had a score over 9.

### **Supplementary oxygen requirement of ventilation during adaptation**

Petropoulos et al.<sup>16</sup> found no differences in the need for supplementary oxygen in neonates born with general or epidural anesthesia C-section (OR 0.85 [95% CI 0.30–2.41]). Another more recent trial did find differences: the percentage of neonates requiring oxygen or positive pressure ventilation during neonatal adaptation was 14% for the general anesthesia group, versus 0% for the spinal anesthesia group ( $p = 0.001$ ).<sup>18</sup> None required tracheal intubation or ICU admission.

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## **Conclusion**

Although the preferred anesthetic technique for cesarean section delivery is neuraxial anesthesia, when the indication for the procedure is under general anesthesia, there is no increased risk of maternal death or unfavorable neonatal clinical outcomes. Mortality may be more linked to the indication

for cesarean section rather than with the anesthetic technique.

The scale tips in favor of neuraxial anesthesia when considering variables such as post-operative pain, bleeding, surgical site infection and patient satisfaction.

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## Funding

Own resources.

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## Conflict of interests

None.

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