Research study

General endotracheal anaesthesia for lower-segment caesarean section: a vanishing art?

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Abstract

Introduction
The aim of this study was to compare Indian scenario with Western scenario in the context of general anaesthesia (GA) given to obstetric patients and to emphasize the lack of resident experience in providing GA for caesarean delivery in anaesthesiology training programs in Western countries.

Materials and methods
Data about caesarean sections, type of anaesthesia used and resident training were collected retrospectively in JIPMER over a period of 12 months, April 2009 to March 2010. Data collected in JIPMER were compared with the western data obtained from published literature.

Results
The proportion of caesarean section carried out in Jawaharlal Institute of Postgraduate Medical Education & Research (JIPMER) during the period 2009–2010 stood at 15.95%. Regional anaesthesia is the anaesthetic technique of choice, which is supported by the evidence that 85% of caesareans were done under regional anaesthesia. A total of 393 cases were done under GA. Average number of GA for caesarean section per final-year anaesthesia resident in our institute was 65 (range: 50–80). A recent survey reported that in the United States the mean number of general anaesthetics for caesarean delivery per graduating GA III resident is less than 5, and 13% had never provided GA during caesarean delivery.

Conclusion
GA is indicated in high-risk parturients who are already in a compromised state. Providing GA to a high-risk parturient is much more challenging and requires specialized training. The risk to the mother and the foetus increases when GA is undertaken on emergency basis. Lack of training to deal with such situations can become a major contributing factor in maternal and foetal morbidity and mortality.

Introduction
Caesarean delivery is one of the most commonly performed surgical procedures all over the world. The choice of anaesthesia for caesarean section is regional, unless general anaesthesia (GA) is specifically indicated. However, Cochrane review in 2007 has shown that no one method is superior to the other in terms of major maternal or neonatal outcome. Thus, selecting either regional or general anaesthesia usually depends on the clinical situation. Other criteria such as estimated blood loss, which appears to reduce with the use of regional anaesthesia, client satisfaction and decreased nausea and vomiting associated with GA also influence decision-making. Any of these may assume greater importance, depending on the context in which one is operating. In low- and middle-income countries, a safe and inexpensive method should be chosen. There are few indications in obstetrics that warrant the use of GA, and it is noteworthy that these indications occur in women who are already compromised (Figure 1).

Figure 1: Indications of general anaesthesia (UK)
Review of literature reveals that in Western countries anaesthesia resident experience in providing GA for obstetric patients is on a declining trend\(^4,5\) (Figure 2). This prompted us to look at what is happening in this regard in our institute, a tertiary care referral hospital in South India. Our objective was to compare South Indian scenario with Western scenario in the context of GA given to obstetric patients and to emphasize on the lack of resident experience in providing GA for caesarean delivery in anaesthesiology training programs in Western countries.

**Materials and methods**

The authors have referenced some of their own studies in this review. These have been conducted in accordance with the Declaration of Helsinki (1964), and the protocols of these studies have been approved by the relevant ethics committees of the institutions in which they were performed. All human subjects in these referenced studies gave informed consent to participate.

This was a retrospective study done in the Department of Obstetrics & Gynaecology and Department of Anaesthesiology & Critical care in JIPMER, Puducherry, over a period of 12 months, from April 2009 to March 2010. Data about caesarean sections, type of anaesthesia used and anaesthesia resident training were collected from confinement register maintained in the Department of Obstetrics & Gynaecology and duplicates of anaesthesia charts used during caesareans and filed in the Department of Anaesthesiology. Confinement register is a reliable source of data, since all deliveries happening in JIPMER are recorded in that register. The data regarding caesarean sections, type of anaesthesia used and anaesthesia resident training were compared with their corresponding Western data in published literature.

**Results**

Total number of deliveries that took place during the study period was 16,363. On the whole, 2,610 women delivered through caesarean section, with the proportion of caesarean section going up to 15.95%. Regional anaesthesia was the anaesthetic technique of choice as evidenced by the fact that 85% of caesareans were done under regional anaesthesia. Out of 15% of patients who underwent caesarean under GA, 10.65% (\(n = 285\)) received GA as a first choice. Failed spinal was the indication for GA in 1.9% of women. In 2.2% of women (\(n = 59\)) both regional and GA were used in view of inadequate sensory block, prolonged surgery and haemodynamic instability. GA is the first choice in the following situations: emergency situations and complicated conditions such as foetal distress, cord prolapse, eclampsia, obstetric haemorrhage, imminent uterine rupture in post-caesarean pregnancies, cardiac conditions (peri-partum cardiomyopathy, mitral stenosis) and spinal deformities.

<table>
<thead>
<tr>
<th>Table 1. Cesarean section and anaesthesia in JIPMER during 2009–2010.</th>
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</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
</tr>
<tr>
<td>Total number of deliveries</td>
</tr>
<tr>
<td>Total number of caesarean sections</td>
</tr>
<tr>
<td>Done under regional anaesthesia (85%)</td>
</tr>
<tr>
<td>Done under general anaesthesia (15%)</td>
</tr>
<tr>
<td>General anaesthesia as first choice</td>
</tr>
<tr>
<td>Failed spinal</td>
</tr>
<tr>
<td>Intubated midway between surgery</td>
</tr>
</tbody>
</table>

we found that the admission rate of postgraduate students at JIPMER is six students per year. Out of 344 women who received GA for caesarean, as much as 90% were given GA by final-year anaesthesia residents. Average number of GA for caesarean section per final-year anaesthesia residents in our institute was 65 per student (range: 50–80)

Discussion

Caesarean sections are increasing in epidemic proportions all over the world. On average, 15% of births worldwide occur through caesarean sections. The highest rate (29.2%) is seen in Latin America and the Caribbean, and the lowest (3.5%) in Africa. Overall, in developed countries, the proportion of caesarean births is 21.1%. It stands at 15.95% in JIPMER. The choice of anaesthesia for caesarean sections has shifted from GA to regional over the past few decades (Table 2). The same trend has been observed in JIPMER as well, and 85% of caesareans done in JIPMER used regional anaesthesia.

The rate of mortality associated with regional anaesthesia has decreased by almost 80%, compared to that observed in a survey conducted in 1990 during the period 1980–1990. The most likely reason for this decline in the rate of mortality is the use of regional anaesthesia and, in turn, more experience for anaesthesiologists in providing regional anaesthesia. The anaesthetic-related maternal mortality rate is approximately 0.17 per 100,000 live births, but the absolute number of deaths related to GA (associated most frequently with airway problems) has not decreased. The absolute risk of maternal mortality associated with GA for caesarean delivery is about 32 per 1,000,000 general anaesthetics, a 17-fold rise in the risk of anaesthetic-related maternal mortality as compared with patients receiving regional anaesthesia for caesarean delivery. Obviously, GA for caesarean delivery is less frequently administered. In the United States, as much as 15% to 22% of caesarean deliveries are accomplished with GA. However, one half of anaesthetic-related deaths occur because of unsuccessful airway management (failure to ventilate, failed intubation, aspiration), a problem more specific to administration of GA. GA is more often chosen for emergency caesarean delivery and regional anaesthesia is chosen for a non-emergency caesarean delivery. Moreover, the incidence of failed tracheal intubation in the obstetric population is 1 out of 250, approximately 10 times more frequent than in the general surgical patient population. It is disturbing that this number has not decreased over the past 10 years. The most intriguing reason that has been proposed is the lack of resident experience in providing GA for caesarean delivery in anaesthesiology training programs. A recent survey reported that in the United States the mean number of general anaesthetics for caesarean delivery per graduating CA III resident is less than 5, and 13% have never provided GA during caesarean delivery. Table 3 shows a comparison of GA experience among trainees in India and abroad.

Conduct of GA: is it an art?

Conduct of GA for lower-segment caesarean section (LSCS) requires expertise and experience. GA is considered as the anaesthetic of choice when the maternal or foetal life is at risk and when significant co-morbid conditions exist in the mother. Apart from administering GA under challenging circumstances, certain special considerations are to be kept in mind for conduct of safe GA.

Prophylaxis against acid aspiration

All parturients are considered to be at high risk for aspiration due to a relaxed oesophageal sphincter caused by progesterone, prolonged gastric emptying time and pressure

Table 2. Shift of anaesthesia from general anaesthesia to regional anaesthesia for caesarean section.

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Percentage</th>
<th>Year</th>
<th>Percentage</th>
<th>Year</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>1982</td>
<td>76</td>
<td>1998</td>
<td>7.7</td>
<td>2006</td>
<td>—</td>
</tr>
<tr>
<td>UK</td>
<td>1982</td>
<td>50</td>
<td>1998</td>
<td>—</td>
<td>2006</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 3. Comparison of general anaesthesia experience among trainees in India and abroad.

<table>
<thead>
<tr>
<th>Description</th>
<th>India</th>
<th>Australia</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of deliveries per year</td>
<td>16,363</td>
<td>5,789</td>
<td>3,000–5,000</td>
</tr>
<tr>
<td>Caesarean section rate (%)</td>
<td>16</td>
<td>34.5</td>
<td>30–40</td>
</tr>
<tr>
<td>General anaesthesia (GA) performed for caesarean section (%)</td>
<td>15</td>
<td>7</td>
<td>7.7</td>
</tr>
<tr>
<td>Mean number of GA performed for caesarean section per resident</td>
<td>100</td>
<td>20</td>
<td>&lt;5</td>
</tr>
</tbody>
</table>
of gravid uterus on the diaphragm. $H_2$ receptor antagonists (Ranitidine 150 mg orally or 50 mg intravenously) or proton-pump inhibitors (e.g. pantoprazole 40 mg intravenously) are routinely used to reduce acid aspiration and the subsequent risk of chemical pneumonitis in many centres. Sodium citrate is also preferred, due to its advantage of instantaneous efficacy. The use of pro-kinetic agents for this goal (e.g. metoclopramide 10 mg orally) is not as widespread as it once was.11

Rapid-sequence induction

**Patient position**

To prevent neonatal depression, induction is usually carried out after the patient is catheterized, the abdomen is draped, and surgeons scrubbed. Left lateral tilt is recommended to avoid aorto-caval compression. A 30° head-up tilt is preferred as it is found to be useful in improving maternal well-being through an increased functional residual capacity (FRC), reduced breast interference to intubation and reduced gastro-oesophageal reflux.12

**Pre-oxygenation**

As FRC reduces by up to 40% and oxygen consumption increases by 20%, oxygen reserves are rapidly depleted.13 This warrants pre-oxygenation with 100% oxygen via a tight-fitting mask. This can be achieved by tidal volume breathing for 3 minutes or performing 4, 5 or 8 vital capacity breaths. Difficult mask ventilation (DMV) is anticipated in obese women, pre-eclamptic oedematous women and those with a short neck. Authors suggest that in patients with predicted DMV, placement of naso-pharyngeal airway can be achieved prior to the induction of anaesthesia without patient discomfort, to optimize facemask ventilation following induction of anaesthesia.

**Intravenous induction agents**

Rapid-sequence technique is preferred for induction of GA. Thiopentone (5 mg/kg of lean body weight) and succinylcholine are currently the agents of choice. Recently, researchers have suggested that rocuronium–sugammadex combination may replace succinylcholine in the near future.10,11 Sugammadex, a selective relaxant-binding agent, antagonizes the effects induced by rocuronium on muscle tissue and quickly resolves neuromuscular blockade. Therefore, in situations when a fast onset and short duration of muscle relaxant is required, rocuronium has a reasonably rapid onset, which can be reversed with sugammadex. Propofol is not preferred in obstetrics due to associated poorer neonatal profile, shorter duration of amnesia (potentially leading to awareness) and longer time to recovery of spontaneous ventilation. Other drugs that can be used in pregnancy are etomidate and ketamine.13,14

**Cricoid pressure**

Ideally cricoid pressure of 10 N should be applied on the cricoid cartilage towards the body of C6, and the pressure should be directed perpendicular to the tilted table. Cricoid pressure is increased to 20 to 40 N after induction and kept in place until tracheal intubation with ETCO$_2$ is confirmed and till the cuff of the tracheal tube is inflated. Endobronchial intubation can be excluded by auscultating the chest.15

**Opioids**

Due to placental transfer of the drug and known incidence of low APGAR in neonates, opioids are usually avoided in obstetric cases. To suppress the laryngeal reflexes during laryngoscopy, non-opioidal drugs like esmolol, nitroglycerine and magnesium sulphate can be used. However, in pregnancies complicated by severe
Monitoring of ETCO₂ is found to be beneficial during GA in obstetric patients. (ASA) standard monitoring is recommended during GA in obstetric patients. Monitoring of ETCO₂ is found to be beneficial in preventing oesophageal intubation and endobronchial intubation. BIS (bispectral index) monitoring is not found to be superior to measurement of end-tidal concentration of volatile anaesthetics in preventing awareness. Anaesthesia is generally maintained with inhalation agents like isoflurane and sevoflurane. Halothane is usually avoided because of its uterine-relaxant activity. Nitrous oxide is preferred by some practitioners due to its rapid onset and intra-operative analgesia. End-tidal agent monitoring can be used to titrate the anaesthetic depth, with the knowledge that minimum alveolar concentration is decreased by up to 40% for pregnant patients. FIO₂ should be guided by pulse oximetry; any level above 0.33 may be used.

The use of supraglottic devices for GA in obstetric patients

Supraglottic airway devices are rescue devices that can be used to maintain oxygenation in women with DMV as well as in those with difficult intubation. The LMA Proseal™ holds great potential in the management of the obstetric airway. The LMA Proseal™ incorporates a second tube intended to permit continuity with the gastrointestinal tract and isolation from the airway, minimizing gastric insufflations during positive-pressure ventilation. Therefore, LMA Proseal™ has great use in the obstetric difficult-airway algorithm. Other supraglottic devices, which can be used in similar scenarios, are LMA classic, LMA supreme and I-gel.

Perioperative care

American Society of Anesthesiologists (ASA) standard monitoring is recommended during GA in obstetric patients. Monitoring of ETCO₂ is found to be beneficial in preventing oesophageal intubation and endobronchial intubation. BIS (bispectral index) monitoring is not found to be superior to measurement of end-tidal concentration of volatile anaesthetics in preventing awareness. Anaesthesia is generally maintained with inhalation agents like isoflurane and sevoflurane. Halothane is usually avoided because of its uterine-relaxant activity. Nitrous oxide is preferred by some practitioners due to its rapid onset and intra-operative analgesia. End-tidal agent monitoring can be used to titrate the anaesthetic depth, with the knowledge that minimum alveolar concentration is decreased by up to 40% for pregnant patients. FIO₂ should be guided by pulse oximetry; any level above 0.33 may be used.

Conclusion

GA is warranted in high-risk patients who are already in a compromised state. Providing GA in high-risk parturients is much more challenging and requires specialized training. The risk to the mother and the foetus increases when GA is undertaken on emergency basis. Lack of training to deal with such situations can become a major contributing factor in maternal and foetal morbidity and mortality.

The possible solutions to overcome this problem are simulation-based training. These high-end simulators are very expensive and dedicated simulators for obstetric anaesthesia training are yet to be developed. A more viable solution can be training through exchange programs. Even though the percentage of caesarean sections performed under GA is similar to that in Western countries, training can be imparted in India as number of deliveries is almost 3 times higher and there exists a large spectrum of complicated obstetric cases. One of the challenging cases we faced was that of a pituitary dwarf, who was just 93 cm and presented to us in obstructed labour. This was a challenge in view of small mouth and difficult airway. In this case, even though the women looked like a child, she required adult-size endotracheal tube for intubation. This was correlated with the appearance of her fingers, which were quite stubby. Another challenging case we faced was that of a 30-year-old woman with thoracic kyphosis, who needed a caesarean section. This patient had severe lung restriction and restricted neck extension, making it extremely difficult for the managing anaesthesiologist.

References