Etiology and Incidence of Endotracheal Intubation Following Spinal Anesthesia for Cesarean Section*

Carin Hagberg MD[1], Tiberiu Ezri MD[3] and Ezzat Abouleish MD[2]

Departments of [1]Anesthesiology and [2]Obstetric Anesthesia, University of Texas Medical School at Houston, Houston, TX, USA; and [3]Department of Anesthesiology, Wolfson Medical Center, Holon [affiliated to Sackler Faculty of Medicine, Tel Aviv University], Israel

Key words: spinal anesthesia, endotracheal intubation, obstetrics, cesarean section

Abstract

Background: The incidence of spinal failure necessitating general anesthesia and endotracheal intubation following spinal anesthesia for cesarean section is extremely low. Aspiration prophylaxis prior to spinal anesthesia is often recommended in case of spinal failure or excessive spinal block requiring the emergency administration of general anesthesia.

Objectives: To determine the incidence of endotracheal intubation following spinal anesthesia for cesarean section.

Methods: We retrospectively reviewed the peri-operative course of parturients undergoing cesarean section under spinal anesthesia at our institution from February 1991 to December 1993. If spinal failure occurred, 10 ml of sodium bicarbonate was administered by mouth prior to induction of general anesthesia.

Results: Among the 743 cases that we reviewed, spinal failure occurred in 15 patients (2%) because of inadequate analgesia in 14 patients (1.9%) and unexpected prolonged surgery for hysterectomy in one patient (0.1%). No patient required intubation due to excessive spinal block. In none of the patients was a record of pulmonary aspiration identified.

Conclusions: The extremely low incidence of spinal failure or excessive block necessitating endotracheal intubation suggests that routine aspiration prophylaxis may not be necessary prior to spinal anesthesia. However, these results should be confirmed by a prospective, controlled study on larger populations. An antacid should be readily available and administered whenever general anesthesia is required.

IMAJ 2001;3:653–656

Since the first clinically relevant report by Mendelson in 1946 [1], aspiration of gastric contents during obstetric anesthesia is recognized as one of the leading causes of anesthesia-related maternal death. The incidence of aspiration in non-pregnant patients is approximately 7/10,000 [2,3], but is much higher in pregnant women receiving general anesthesia, ranging from 1.3 to 22.8/10,000 [4–7] with a 6% mortality rate [6].

Aspiration prophylaxis is often recommended prior to cesarean section under spinal anesthesia to avoid possible spinal failure, which requires the emergency administration of general anesthesia. The incidence of spinal failure, defined as the need to add general anesthesia to the block during the surgical procedure, ranges from 0.46 to 17% [8–11]. The aim of this study was to determine the incidence of endotracheal intubation secondary to either spinal failure, which requires the conversion to general anesthesia, or excessive spinal block, which requires securing the airway and ventilatory support.

Materials and Methods

We retrospectively reviewed the peri-operative course of all parturients (743 patients) who underwent CS under spinal anesthesia at Hermann Hospital, Houston, Texas, from February 1991 to December 1993. According to the protocols in this teaching hospital, spinal anesthesia was performed either by a resident under the supervision of a staff member or directly by a staff member. The intrathecal injectate consisted of 0.75% hyperbaric bupivacaine in a dose of 8.25 mg (1.1 ml) for a height of 150 cm, plus the addition of 0.75 mg (0.1 ml) for each 7.5 cm above this height, along with 0.2 ml epinephrine and 0.2 mg morphine [12]. Most of the spinals were performed at the L2-3 interspace, using a 25 or 26 G Quinke needle, with the patients in the sitting position. If the sitting position or the L3-4 interspace was used, the dose of bupivacaine was increased by 1.5 mg (0.2 ml). Monitoring consisted of electrocardiography, non-invasive blood pressure, and pulse oximetry. Temperature, capnography and concentration of anesthetic agent were also monitored for procedures requiring general anesthesia. The sensory level of the block was assessed by pinprick and recorded at 2, 5, 10, 15 and 20 minutes from induction of spinal anesthesia. None of the patients were given routine aspiration prophylaxis before spinal anesthesia, and none received a second spinal anesthetic if the first attempt resulted in an inadequate or absent block. Three patients in whom epidural for

* Part of the data presented in this study were published in a "Letter to the Editor" in the *Canadian Journal of Anaesthesiology* 2000;47:95–6.

CS = cesarean section

labor failed had a successful spinal block. Patients who received epidural anesthesia for the CS as a continuation of an epidural analgesia for labor were excluded from the study. Spinal anesthesia was performed in all patients undergoing CS provided they did not have an epidural or there was no contraindication to performing spinal anesthesia (i.e., coagulopathy, patient's refusal, infection at the injection site, and emergency CS due to hemorrhage or severe fetal distress).

Table 1. Indications for cesarean section

Mother*	%	Fetus*	%
Previous cesarean section	36.66	Abnormal presentation	28.48
Failure to progress	5.91	Non-reassuring fetal heart rate abnormality	5.30
Pregnancy-induced hypertension	3.18	Cephalopelvic disproportion	6.21
Genital herpes	2.27	Preterm labor	5.76
Failed induction	2.27	Multiple gestations	5.76
Abnormal vagina/ uterus	2.13	Macrosomia	2.58
Non-bleeding placenta previa	3.79	Oligohydramnios	2.27
Placental abruptio**	0.76	Others	2.27

* In some cases both maternal and fetal indications occurred

** Diagnosed by sonography; stable vital signs

If spinal anesthesia was inadequate, the obstetrician was informed and instructed to delay the CS until general anesthesia was induced and the airway secured. These patients were given 10 ml of sodium bicarbonate by mouth [13], preoxygenated with 100% oxygen, then induced in a rapid sequence manner using sodium thiopental and succinylcholine with application of cricoid pressure. Anesthesia was maintained with isoflurane and a mixture of 50% nitrous oxide and oxygen. After delivery under spinal anesthesia, droperidol was given if required in 0.625 mg increments intravenously for the treatment of nausea and vomiting. Transient discomfort or mild pain was treated with fentanyl (50–100 μg IV). Hypotension was prevented or treated by either intravenous boluses (5–10 mg) or infusion (solution of 0.1 mg/ml) of ephedrine [14].

Results

The patients' mean age was 26 ± 6 years and body mass index 31 ± 3. Ninety-one percent of the patients were fasting for more than 8 hours CS was urgent and emergency in 42%. Indications for cesarean section are given in Table 1. Data regarding the performance of spinal anesthesia (patient's position, number of attempts to obtain cerebrospinal fluid, and interspace used) are presented in Table 2.

Spinal failure requiring general anesthesia occurred in 15 patients (2%). Partial or no analgesia after an apparent satisfactory block was reported in 14 patients (1.9%), and prolonged surgery for unexpected hysterectomy (4 hour procedure) occurred in 1 patient (0.1%). No patient required intubation due to excessive spinal block. Data concerning the outcome of spinal block are shown in Table 3. There were no differences with regard to the failure rate and height of the block between the spinals performed in the sitting versus lateral position. Despite the fact that 117 patients (15.7%) had a higher than T4 level (1.2% reaching the C_2-C_5 level), ventilation, oxygenation and hemodynamic status remained well preserved (blood pressure and heart rate did not decrease or increase by more than 20% of the pre-spinal values).

There were no side effects recorded in the charts. No patient required intubation due to excessive spinal block, and no patient suffered from pulmonary aspiration.

Table 2. Performance of spinal anesthesia

	%
Patient position	
Lateral	39.90
Sitting	60.10
No. of attempts	
1	51.90
2	36.20
3	7.30
>3	4.60
Interspace level	
L_{2-3}	60.57
L_{3-4}	39.43
Dose of hyperbaric bupivacaine*	10.8 ± 2.3 mg

* Mean ± SD

Table 3. Outcome of spinal anesthesia

	%
Sensory level	
Mean block height at 20 min*	T_5 ± 1.6
Maximum block height reached	
> T_6	2.0
T_6-T_4	82.3
T_3-C_6	14.5
C_6-C_2	1.2
Reasons for spinal failure	
Insufficient analgesia	1.9
Prolonged surgery	0.1
Incidence of aspiration	0.0
Drug supplementation	
Ephedrine	60.6
Droperidol	63.2
Fentanyl	16.4

* Mean ± SD

Discussion

While the risk factors for aspiration pneumonitis during pregnancy are well recognized, most of them can be avoided by fasting, prophylactic antacid therapy, and rapid sequence induction of anesthesia with application of cricoid pressure [15] or performance of regional anesthesia whenever possible.

In our institution most of the elective and emergency cesarean sections are performed under either spinal or epidural anesthesia. During the time of this review, spinal anesthesia was the most commonly used technique (52%), followed by epidural anesthesia (34%); general anesthesia was used the least (14%). We believe that spinal anesthesia for CS is simpler, is associated with decreased cardiovascular responses to surgically induced stress, provides excellent postoperative analgesia and avoids manipulation of the airway. We also consider it superior to epidural anesthesia for CS because it is easier to perform, has a more rapid onset time and provides better analgesia [16]. Additionally, spinal anesthesia avoids the danger of inadvertent intravascular or intrathecal injection of large doses of local anesthetics, has a lower incidence of severe headaches requiring epidural blood patch than inadvertent spinal taps caused by a large epidural needle, and is more cost-effective [17]. As stated earlier, the reported incidence of spinal failure is variable, ranging from 0.46 to 17%. It is interesting that in spite of the improvement in spinal needles and pharmacological agents, the rate of spinal failure has not decreased over the last 45 years [1–6]. This could be explained by poor technique, infrequent use, inadequate training, and use of tetracaine [11].

Our relatively high success rate in performing spinal anesthesia without an excessive conduction block could be explained by several factors. First, it is always performed under the direct supervision of a staff anesthesiologist. Second, we use a reduced dose of local anesthetic and supplement it with epinephrine and morphine. This combination of local anesthetic, plus adrenergic and opioid drugs, has provided safe and reliable analgesia in our department over many years [12]. Third, hyperbaric bupivacaine allows a favorable differential between sensory and motor block [18], which could explain the lack of ventilatory compromise in our patients with a high sensory level. The mean dose of hyperbaric bupivacaine in this study was 10.8 $\pm$ 2.3 mg. This balanced technique of regional anesthesia – namely the use of a smaller dose of bupivacaine, epinephrine and morphine – is employed as an alternative to the administration of higher doses of bupivacaine [19]. Fourth, there must be CSF free flow prior to administering the anesthetic agents. Finally, since spinal anesthesia has become the preferred anesthetic technique for both elective and emergency CS, the success rate may be high because of its frequent utilization.

However, spinal anesthesia may be associated with severe hypotension, bradycardia and arrhythmias. In a recent published study, Shen et al. [20] reported severe bradycardia (heart rate < 50 beats per min) in 6.7%, first- and second-degree atriovenous block in 3.5%, and ventricular premature contraction in 1.2% of patients undergoing CS under spinal anesthesia. Older age increased the risk of arrhythmias. The reason for the hemodynamic stability in our patients could be the lower dose of spinal local anesthetic and the preventive use of a continuous infusion of ephedrine.

Pre-operative aspiration chemoprophylaxis may include antacids, H_2-receptor blockers and metoclopramide. Non-particulate antacids (sodium citrate and bicarbonate) given within 30 minutes before surgery effectively raise gastric pH values above 2.5 [13,21]. Not only do H_2-receptor antagonists raise gastric pH but they also act to reduce gastric secretion volume [22]. The slow onset time of these agents (45–60 min after IV injection and 240–360 min after oral administration) limits their use in emergency cases. Metoclopramide enhances gastric emptying and increases lower esophageal sphincter pressure, although it does not affect gastric acid secretion [23]. Anti-emetic effects may result from its antagonism of central and peripheral dopamine receptors and inhibition of chemoreceptor trigger zone-mediated vomiting [23]. We do not routinely use metroclopramide because of the possible adverse effects involving the cardiovascular system (e.g., hypertension, hypotension and dysrrhythmias), as well as those involving the central nervous system (e.g., drowsiness, extrapyramidal reactions and anxiety).

Pharmacological aspiration prophylaxis before anesthesia for CS has been extensively employed. Plumer and Rothman [24] recently reported that 88.5% of anesthesiologists attending a major obstetric anesthesia conference in the USA routinely use aspiration prophylaxis for elective cesarean delivery performed under regional anesthesia. However, in a confidential postal questionnaire among 297 French anesthesiologists, Benhamou [25] found that only 23% of the respondents used aspiration prophylaxis before obstetric anesthesia.

Non-particulate antacids are commonly given before inducing general anesthesia for CS and are routinely administered in our institution. We prefer sodium bicarbonate to sodium citrate because of its smaller volume (10 vs. 30 ml) and more rapid onset of action [13]. The use of oral antacids does not reduce the incidence of aspiration [25], may result in an increased volume of gastric content [15], and may actually cause nausea and vomiting. For these reasons and the fact that aspiration under properly conducted spinal anesthesia is extremely rare, we believe that it is not necessary to routinely administer aspiration chemoprophylaxis before spinal anesthesia for CS. This policy avoids the side effects and enhances the cost-effectiveness of anesthesia for cesarean section [13].

We conclude that, based on the extremely low incidence of spinal failure or the development of excessive spinal block necessitating endotracheal anesthesia for cesarean section in our institution, routine administration of antacids may not be necessary prior to spinal anesthesia for cesarean section, yet an antacid should be readily available and should be administered in circumstances in which general anesthesia is required.

CSF = cerebrospinal fluid

References

1. Mendelson CL. The aspiration of stomach contents into the lungs during obstetric anesthesia. *Am J Obstet Gynecol* 1946;52:191–205.
2. Ollson GL, Hallen G, Habratus-Jonron K. Aspiration during anaesthesia: a computer aided study of 185,358. *Acta Anaesthesiol Scand* 1986;30:84–92.
3. Cameron JL, Mitchell WM, Zulema CD. Aspiration pneumonia. Clinical outcome following documented aspiration. *Arch Surg* 1973;106:49–52.
4. Crawford JS. The anaesthetist's contribution to maternal mortality. *Br J Anaesth* 1970;42:70–3.
5. Hunter AR, Moir DD. Confidential inquiry into maternal death [Editorial]. *Br J Anaesth* 1983;55:367–9.
6. Kranz ML, Edwards WL. The incidence of nonfatal aspiration in obstetric patients. *Anesthesiology* 1973;39:359.
7. Ezri T, Szmuk P, Stein A, Konichezky S, Hagay T, Geva D. Peripartum general anaesthesia without endotracheal intubation: incidence of aspiration pneumonia. *Anaesthesia* 2000;55:421–6.
8. Moore DC, Brinbenbaugh LD, Bagdi PA, Brindebaugh PO, Stander H. The present status of spinal (subarachnoid) and epidural (peridural) block: a comparison of the two techniques. *Anesth Analg* 1968;47:40–9.
9. Juhani TP, Hannele H. Complications during spinal anesthesia for cesarean delivery: a clinical report of one year's experience. *Reg Anesth* 1993;18:128–31.
10. Glosten B, Chandwick HS, Ross BK, Coda B, Gianas A. Failed regional anesthesia for cesarean delivery [Abstract]. *Anesthesiology* 1995:A977.
11. Levy JH, Islas JA, Ghia JN, Turnbull C. A retrospective study of the incidence and causes of failed spinal anesthetics in a university hospital. *Anesth Analg* 1985;64:705–10.
12. Abouleish E, Rawal N, Tobon-Randall B, Rivera-Weiss M, Meyer B, Wo A, Rashad MN. A clinical and laboratory study to compare the addition of 0.2 mg of morphine, 0.2 mg of epinephrine or their combination with hyperbaric bupivacaine for spinal anesthesia in cesarean section. *Anesth Analg* 1993;77:457–62.
13. Faure EAM, Lim HS, Block BS, Tan PL, Roizen MF. Sodium bicarbonate buffers gastric acid during surgery in obstetric and gynecologic patients. *Anesthesiology* 1987;67:274–7.
14. Kang YG, Abouleish E, Caritis S. Prophylactic intravenous ephedrine infusion during spinal anesthesia for cesarean section. *Anesth Analg* 1982;61:839–42.
15. Kallar SK, Everett LL. Potential risks and preventive measures for pulmonary aspiration: new concepts in preoperative fasting guidelines. *Anesth Analg* 1993;77:171–82.
16. Riley ET, Cohen SE, Macario A, Desoo JD, Ratner EF. Spinal versus epidural anesthesia for cesarean section: a comparison of time efficiency, costs, charges and complications. *Anesth Analg* 1995;80:709–17.
17. Hebert CL, Tetirick CE, Ziemba JF. Complications of spinal anesthesia. *JAMA* 1950;142:551–7.
18. Abouleish EI, Abramson DC, Minkowitz HS, His BP. The spread of hyperbaric spinal bupivacaine in cesarean section correlates with body mass index [Abstract]. *Anesthesiology* 1994;83:A839.
19. DeSimone CA, Leighton BL, Norris MC. Spinal anesthesia for delivery: a comparison of two doses of hyperbaric bupivacaine. *Reg Anesth* 1995;20:90.
20. Shen CL, Ho YY, Hung YC, Chen PL. Arrhythmias during spinal anaesthesia for Cesarean section. *Can J Anaesth* 2000;47:393–7.
21. Gibbs CP, Spohr L, Schmidt D. The effectiveness of sodium citrate as an antacid. *Anesthesiology* 1986;57:44–6.
22. McCaughey W, Howe MP, Moore J, Dundee JW. Cimetidine in elective cesarean section. *Anaesthesia* 1981;36:167–72.
23. Howard FA, Sharp DS. Effects of metoclopramide on gastric emptying during labour. *Br Med J* 1973;1:446.
24. Plumer MH, Rothman R. How anesthesiologists practice obstetric anesthesia. *Reg Anesth* 1996;21(21):49–60.
25. Benhamou D. French obstetric anaesthetists and acid aspiration prophylaxis. *Eur J Anaesthesiol* 1993;10:27–32.

Correspondence: Dr. T. Ezri, Director, Dept. of Anesthesiology, Wolfson Medical Center, Holon 58100, Israel. Phone: (972-8) 947-5188 or (972-3) 502-8229, Fax: (972-3) 502-8228, email: etb@netvision.net.il