

# Simultaneous cesarean delivery and craniotomy in a term pregnant patient with traumatic brain injury

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## ABSTRACT

The management of pregnant patients with traumatic brain injury is challenging. A multidisciplinary team approach is mandatory, and management should be individualized according to the type and extent of injury, maternal status, gestational age, and fetal status. We report a 27-year-old term primigravida presenting after head injury with Glasgow coma scale score 11 and anisocoria. Depressed temporal bone fracture and acute epidural hematoma were diagnosed, necessitating an urgent neurosurgery. Her fetus was viable with no signs of distress and no detected placental abnormalities. Cesarean delivery was performed followed by craniotomy in the same setting under general anesthesia with good outcome of the patient and her baby.

**Key words:** Cesarean section, craniotomy, pregnancy, traumatic brain injury

## INTRODUCTION

Trauma affects 7-8% of all pregnancies.<sup>[1,2]</sup> It is the leading cause of nonpregnancy related maternal death,<sup>[1,2]</sup> and is associated with adverse fetal outcomes.<sup>[1]</sup>

Maternal resuscitation follows the standard guidelines for trauma management, while definitive management is complex and should be individualized.<sup>[1,2]</sup> Delivery of the fetus may occur unintentionally or by cesarean section during the period of trauma admission that further complicates the situation.<sup>[1]</sup>

We present a case of traumatic brain injury (TBI) occurring in a term pregnant woman who underwent simultaneous cesarean delivery and neurosurgery under general anesthesia. Specific anesthetic challenges are briefly discussed. A written consent was obtained from the patient to publish her data.

## CASE REPORT

A 27-year-old primigravida (height: 165 cm, weight:

80 kg) at 37 weeks' gestation presented to the emergency department 1 h after blunt head trauma caused by falling of a heavy object on her head. Past medical history and history of the current pregnancy were unremarkable.

On examination, she was spontaneously breathing with a respiratory rate of 25 breaths/min. Her blood pressure (BP) was 110/80 mmHg, heart rate was 110 beats/min, blood glucose level was 117 mg/dl, Glasgow coma scale score was 11 (E4, V2, M5), and her left pupil was dilated and nonreactive to light. A lacerated wound over the left temporal region was noticed. Computed tomographic scan of the head revealed a depressed left temporal bone fracture and a large acute left temporo-parietal epidural hematoma causing midline shift, obliteration of sulci, and effacement of the left lateral ventricle.

No other injuries were clinically detected. Focused assessment with sonography for trauma examination and cervical spine radiography were normal. Hemoglobin (Hb) concentration was 9 g/dl, arterial blood gas analysis showed mild respiratory alkalosis, whereas other laboratory values were normal. Obstetric examination utilizing ultrasonography and cardiotocography revealed a full term viable fetus with good biophysical profile, with no signs of placental abnormalities or fetal distress.

After discussing the risks and benefits of the management options among the managing physicians and the patient's family, we decided to perform cesarean delivery followed

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by craniotomy. Intravenous (IV) ranitidine 50 mg and metoclopramide 10 mg were administered for aspiration prophylaxis. In the operating room, the patient was placed in a 30° head up position with 15° left lateral tilt. Monitoring included invasive BP, electrocardiography, pulse oximetry and capnography.

General anesthesia was induced with a smooth, rapid sequence technique with cricoid pressure. IV fentanyl 80 µg, thiopentone 400 mg, and succinylcholine 100 mg were administered. An orogastric tube was inserted after tracheal intubation to empty the stomach. Anesthesia was maintained with isoflurane 0.6-1% in 60% O<sub>2</sub> in air mixture, and muscle relaxation was accomplished with intermittent IV boluses of atracurium. End-tidal CO<sub>2</sub> was maintained at 28-32 mmHg throughout the delivery and the neurosurgical procedure.

A healthy, 3200 g female infant was delivered after 8 min of induction of anesthesia with Apgar scores of 8 and 10 at 1 and 5 min, respectively. After delivery, oxytocin (5 U slowly IV over 5 min, followed by infusion of 20 U in 500 ml normal saline over the next 4 h) and fentanyl 100 µg were administered, and preparation for the neurosurgery started.

Craniotomy and evacuation of the epidural hematoma were performed over the next 2 h. Isoflurane concentration was kept at or below 1% to avoid excessive uterine relaxation. Propofol infusion at a rate of 75-150 µg/kg/min was started and adjusted to keep the mean arterial pressure (MAP) between 75 and 95 mmHg. Intraoperative blood glucose was 145 mg/dl and Hb concentration was 8.5 g/dl. One unit of packed red blood cells was administered.

At the end of the procedure, bilateral transversus abdominis plane block was performed with 20 ml of 0.25% bupivacaine on each side, and IV fentanyl 50 µg and paracetamol 1 g were administered. The patient was transferred to the intensive care unit, and ventilated with pressure support ventilation for 3 h; then her trachea was extubated after attaining adequate conscious level and motor power.

In the next day, she was fully conscious and hemodynamically stable, and her laboratory values were normal. She was transferred to the ward for 3 days then was discharged home in a good condition with her baby.

## DISCUSSION

The primary management goals of pregnant trauma victims are optimal maternal resuscitation and early fetal assessment.<sup>[2]</sup> Maternal resuscitation follows the general

guidelines for trauma management, with appreciation of the physiological, pharmacological, and radiological issues specific to pregnancy.<sup>[1,2]</sup> The fetus should be assessed during or immediately after maternal stabilization, and viable fetuses should be monitored by cardiotocography for at least 2-6 h after trauma.<sup>[1,2]</sup>

The standard guidelines for the management of TBI<sup>[3-5]</sup> can be applied for pregnant patients with appropriate modifications. Management involves a multidisciplinary team including neurosurgeon, obstetrician, anesthesiologist, radiologist, and neonatologist, and depends on the degree of injury, maternal status, gestational age, and fetal status.<sup>[6]</sup>

In a term or near-term pregnant woman who will undergo neurosurgery for TBI, obstetric management mainly depends on fetal status. Emergency cesarean delivery is indicated in the presence of fetal distress or suspected placental abruption.<sup>[7,8]</sup> In our case, there were no dangerous fetal or placental signs and 3 possible management options existed.

First, it was possible to perform neurosurgery without attempt of delivery with continuous electronic fetal heart rate monitoring, and readiness to deliver the baby immediately if fetal distress developed. This avoids performing 2 simultaneous surgical procedures and gives the patient a chance for later vaginal delivery. However, abnormalities of fetal heart rate tracing during general anesthesia is not uncommon and may be misinterpreted as fetal distress leading to unnecessary obstetric intervention.<sup>[9]</sup> Moreover, vaginal delivery after a recent neurosurgery is dangerous due to the deleterious effects of labor pain, uterine contractions, and straining on intracranial pressure (ICP) and cerebral blood flow (CBF).<sup>[10]</sup>

Another option was to perform the neurosurgery first followed by cesarean delivery, to shorten the time between brain injury and surgical evacuation to obtain the best neurological outcome.<sup>[4]</sup> However, prolonged exposure to anesthetic and analgesic drugs, maternal hypotension or hyperglycemia, and specific drugs (e.g., mannitol) and maneuvers (e.g., hyperventilation) in the pre-delivery period carries potential fetal risk. Hence, it seemed that cesarean delivery followed by craniotomy would result in the best maternal and fetal outcomes.

Providing anesthesia for such a patient is challenging. Pregnancy aggravates the preexisting difficulty in airway management of head trauma patients.<sup>[6,11]</sup> Cervical spine injury must be ruled out.<sup>[5]</sup> Hypoxia, hypercarbia, and stress response during tracheal intubation should be avoided to minimize the rise in ICP.<sup>[11]</sup> Aspiration prophylaxis is recommended,<sup>[6]</sup> and induction of anesthesia must be

rapid -albeit smooth- with the potential benefit of adjuvant drugs; short-acting opioids, lidocaine, and esmolol.<sup>[6]</sup>

Hypotension (systolic BP <90 mmHg) should be avoided,<sup>[3]</sup> to ensure adequate cerebral and uteroplacental perfusion,<sup>[6]</sup> while hypertension increases bleeding in the neurosurgical site. Cerebral perfusion pressure (the difference between MAP and ICP) should be maintained at 50-70 mmHg.<sup>[3]</sup>

Both hypo and hyperglycemia are associated with adverse neurological outcomes after TBI, and should be avoided.<sup>[3,11]</sup> Furthermore, maternal hyperglycemia in the pre-delivery period increases fetal insulin secretion and may result in neonatal hypoglycemia.<sup>[12]</sup> Our patient's blood glucose level was 117 mg/dl on admission, and was 145 and 137 mg/dl in the intra and postoperative periods respectively without insulin therapy.

Modest short-term hyperventilation may be temporarily used to reduce the dangerously raised ICP,<sup>[3,5]</sup> or to improve surgical exposure during craniotomy; but prophylactic or aggressive (PaCO<sub>2</sub> <25 mmHg) hyperventilation after TBI should be avoided.<sup>[3,11]</sup> Mild hyperventilation and hypocapnia associate normal pregnancy,<sup>[6]</sup> however, further decrease in maternal PaCO<sub>2</sub> has deleterious fetal effects: Decreased placental O<sub>2</sub> transfer and decreased fetal cerebral tissue oxygenation.<sup>[13]</sup> Hence, maternal PaCO<sub>2</sub> should not be allowed to drop below 25 mmHg.<sup>[6]</sup>

All currently used volatile anesthetics produce dose-dependent uterine relaxation due to a decrease in intracellular free Ca<sup>++</sup> concentration mediated by inhibition of voltage-dependent Ca<sup>++</sup> channels.<sup>[14,15]</sup> This effect starts at concentrations as low as 0.5 minimum alveolar concentration (MAC), and affects both spontaneous and oxytocin-induced uterine contractions.<sup>[14,15]</sup> Isoflurane appears to be the least potent uterine relaxant of the volatile anesthetics with reported ED50 of 2.35 MAC.<sup>[14]</sup> To prevent uterine atony after cesarean delivery, high concentrations (>1 MAC) of volatile anesthetics should be avoided, together with administration of uterotonic drugs and avoidance of other drugs with uterine relaxant effect.

Similarly, propofol has a dose-dependent uterine relaxant effect,<sup>[16,17]</sup> while opioids in doses utilized clinically have no significant uterine relaxant effect.<sup>[18]</sup> The combination of inhalational anesthetic and propofol had been previously used in a patient performing neurosurgery after cesarean delivery.<sup>[19]</sup> However, its effect on human uterine activity has not been studied.

The effects of uterotonic drugs on ICP and CBF are not well studied.<sup>[7]</sup> Different agents including

syntocinon,<sup>[10,20]</sup> carbetocin,<sup>[21]</sup> ergometrine,<sup>[22]</sup> and misoprostol (prostaglandin E1)<sup>[11]</sup> had been used without complications after delivery in patients with various neurological diseases. Syntocinon (synthetic oxytocin) has significant cardiovascular effects, including vasodilation, hypotension, tachycardia, and arrhythmias, especially when administered as a bolus.<sup>[23]</sup> Being structurally similar to vasopressin, oxytocin exerts an antidiuretic effect and had been rarely associated with water intoxication, hyponatremia, seizures, and coma when excessively high doses were infused in large volumes of hypotonic fluid (dextrose 5%).<sup>[24]</sup> Carbetocin is a new synthetic analogue of oxytocin with a more potent and prolonged action than syntocinon and similar side effect profile.<sup>[23]</sup>

Ergometrine causes nausea, vomiting, and hypertension,<sup>[23]</sup> and had been associated with cerebral vasospasm precipitating postpartum cerebral angiopathy; a form of reversible cerebral vasoconstriction syndrome.<sup>[25]</sup> Therefore, its use in the presence of increased ICP is not recommended.<sup>[6]</sup> Prostaglandins F2 alpha, E1 and E2 have a wide range of cardiovascular and smooth muscle effects,<sup>[23]</sup> while their effects on ICP have not been studied. Hence, it appears that syntocinon -and probably carbetocin- may be safely used in patients with intracranial pathologies.

## CONCLUSION

We describe the case of a term pregnant patient who suffered TBI and was managed by cesarean delivery followed by craniotomy under general anesthesia. Management involved a multidisciplinary team to ensure the best outcome of the mother and her fetus. Anesthesia was successfully provided with appreciation of specific obstetric and neurosurgical issues.

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