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Postmortem cesarean: report of our successful neonatal outcomes after severe trauma during pregnancy and review of the literature

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Postmortem cesarean is delivering of a child by cesarean section after the death of the mother. A prompt decision for cesarean delivery is very important in such cases. The survival of both the mother and the baby is dependent on a number of factors, including the time between maternal cardiac arrest and delivery, the underlying reasons for the arrest, the location of the arrest and the skills of the medical staffs. The earlier the fetus is delivered following maternal arrest the better is the fetal survival. Cesarean section should be performed no later than 4 minutes after initial maternal arrest. A fetus delivered within 5 minutes from initiation of CPR (cardiopulmonary resuscitation) has the best chance for survival. We reported 2 cases of successful postmortem cesarean section done 45 and 15 minutes after maternal death. The 1st case was a 29-year-old pregnant woman at 37 weeks gestation with cardiopulmonary arrest following gunshot head injuries. The baby survived with neurological sequels and ongoing treatment at our newborn intensive care unit. Second case admitted to the emergency service was a 28-year-old primigravida of 31 weeks gestation with cardiopulmonary arrest due to massive brain and thoracic hemorrhage after a road traffic accident. The baby recovered without neurological sequels.

Keyword: Cardiopulmonary resuscitation, cardiopulmonary arrest, maternal outcome, neonatal outcome, perimortem section

Introduction

Postmortem cesarean (PMCS) is delivering of a child by cesarean section after the death of the mother. The term cesarean comes from the ruling made by the second king of Rome in 715 BC. This rule allows extraction of baby from the womb of dead, pregnant woman [1].

Schafer published a study which sum up the history of the postmortem caesarean section. At the beginning of the nineteenth century practitioners were legally obliged to carry out this operation. As early as 1845, some authors reported the results of animal experiments which demonstrated that the movements of the fetuses in the womb could continue up until 30 minutes after the death of the mother, some authors suggested that although the mother had been dead for at least 15 minutes, delivery of a live child was possible [2].

A prompt decision for cesarean delivery is very important in such cases [3]. The shorter interval between maternal cardiac

arrest and delivery may increase the chance for both intact maternal and neonatal survival without neurologic sequel.

Katz and colleagues recommended that if there was no response of the woman to basic and advanced life support within 4 minutes perimortem caesarean delivery must be initiated and completed within 5 minutes to ensure the best outcome for the baby and to facilitate the cardiopulmonary resuscitation (CPR) of the mother [4]. In maternal cardiac arrest, advanced cardiac life support (ACLS) must be rapidly administered. CPR must be continued throughout the caesarean section to maintain blood flow and after delivery because this improves the prognosis for mother and child [5]. A study performed by Lipman et al evaluated the quality of obstetric ACLS during the management of a simulated cardiac arrest in a term pregnant patient. This study demonstrated remarkable deficiencies of knowledge and inadequate resuscitation skills among doctors, midwives and other health professionals. The authors reported that only 44% of the medical staff displaced the uterus correctly and that only 56% gave chest compressions at the correct rate [6]. The key factor for successful resuscitation in late pregnancy is that all medical staff concerned with obstetric care should be trained in CPR. Cardiopulmonary arrest in pregnancy is a rare event occurring in 1 in 30,000 pregnancies [7]. Causes for cardiac arrest in pregnancy can be pregnancy-related and no pregnancy-related. Trauma, pulmonary embolism, hemorrhage, hypertension and infection are the leading causes of maternal death in pregnancy [8]. Trauma is the most common nonobstetric cause of morbidity and mortality in pregnancy [9].

We reported 2 cases of successful PMCS section done 15 and 45 minutes after maternal death.

Case 1

A 29-year-old pregnant woman with cardiopulmonary arrest following gunshot head injuries was brought to the emergency department with ambulance. CPR was started in ambulance (she was intubated, i.v. access was obtained and i.v. crystalloid started, i.v. adrenalin administered) and continued in emergency department. Despite extensive CPR cardiac output was not return and the mother died. Abdominal ultrasonography revealed a fetus at 36 weeks gestational age and the presence of 5–10 fetal heartbeat and in about 45 minutes more after maternal injury a living child was delivered by cesarean section. The baby was born with an Apgar score of 1 at 1 and 5 minutes, 2 at 10 minutes. At delivery the baby was cyanotic, hypotonic, bradycardic (heart rate < 20/minutes) and had not spontaneous breathing. The resuscitation was started at emergency department. After intubation, external

cardiac massage and epinephrine administration via endotracheal tube the heart rate was >100/minutes. Blood sample from umbilical artery showed profound metabolic and respiratory acidosis (pH: 6.7, pCO₂:120, HCO₃:7.8, BE:-16). The baby had not responded adequately to resuscitation, poor perfusion, weak pulse, severe hypotension, hypotonia, apnea continued. Only heart rate >100/minutes was obtained. The baby was transferred to the newborn intensive care unit (NICU). On physical examination following resuscitation, the baby had irregular breathing and required ventilatory support. Pressure support ventilation plus volume guarantee (PSV+VG) was started. Inotropic support was admitted due to irregularities of heart rate and blood pressure (severe hypotension). Urine output was less than 1 mL/kg/h, liver function test were elevated and electrolyte imbalances were present. The neurologic examinations revealed the presence of generalized hypotonia and absence of neonatal reflexes (Moro, sucking, swallowing, grasping). Pupils were midpositioned and poorly reactive to light. Lack of eye movements and corneal reflexes was present. In the first 3 hours after birth, the baby had seizure. Cranial ultrasonography was normal. The diagnosis of hypoxic-ischemic encephalopathy: stage 3 of Sarnat classification was done. On 5th day respiratory function gradually improved and the baby was extubated. The baby did not react to any painful stimulus and had not spontaneous movements. The feeding of the baby was provided via a gastrostomy feeding tube. Over time, skewed deviation of the eyes and increased axial extensor tone with spastic quadriplegia were developed. Breathing was irregular, and the baby often required ventilatory support. EEG showed a periodic pattern with isopotential phases. MRI examination showed evidence of low-grade hypoxic-ischemic encephalopathy.

Case 2

Second case admitted to the emergency service was a 28-year-old primigravida of 31 weeks gestation with cardiopulmonary arrest due to massive brain and thoracic hemorrhage after a road traffic accident. In the ambulance spontaneous respiration stopped. She was intubated and chest compression was performed throughout transportation to the hospital. She was placed in a left lateral tilt position during CPR. CPR was continued throughout the caesarean section and after delivery. Despite extensive resuscitation, the mother died and a low-segment caesarean section 15 minutes after arrest was performed by the obstetrician. The operation was done at emergency department. A 1990 g female baby was delivered at 31 weeks of gestation. The neonate Apgar scores were 4, 7, and 8 at 1, 5, and 10 minutes, respectively. At delivery the baby was cyanotic, bradycardic and had not spontaneous breathing. The baby responded to simple resuscitation. After resuscitation at emergency service the baby was admitted to the NICU. The physical examination revealed tachypnea, grunting, retractions and cyanosis accompanied by increasing oxygen requirements. Chest radiography immediately after birth showed signs of respiratory distress syndrome (reticulogranular appearance with air bronchograms) required surfactant (poractant alfa) therapy and ventilatory support (PSV+VG). At 2nd day the baby was extubated and at 3rd day was on room air. The baby was feed via orogastric tube and gained weight well. On 2nd day the hematocrit dropped. There was a bleeding complication during the accident following formation of 3 subcapsular hepatic hematomas. We performed screening for sepsis and coagulopathy, laboratory findings were in normal range. The level of α -fetoprotein was not high. The pediatric surgery consultation was done and conservative management was recommended. The follow-up showed reduction in size of hematomas at ultrasound examination. The baby recovered without neurological sequelae.

Cranial USG, EEG and MRI were in normal range. Neurologic examination performed by a pediatric neurologist was unremarkable. She was discharged at 45 days of age. At 6 months of age the examination did not showed any neurological disturbance.

Discussion

The survival of both the mother and the baby is dependent on a number of factors, including the underlying reason for the arrest, the location of the arrest, and the resuscitation skills of the care providers [7]. The triennial Confidential Enquiries into Maternal and Child Health (CEMACH) reported that neonatal outcomes were improved with increasing gestational age and location of the arrest in a delivery room or operating theatre environment [10].

McDonnell reported 2 cases with good maternal and neonatal outcomes. Both cases described in this report occurred in the hospital and perimortem caesarean deliveries were managed by obstetric and anesthetic staff with experience on management of obstetric emergencies [11]. Cardiac arrest in our cases occurred outside of a hospital; despite extensive resuscitation and performing of postmortem section maternal outcomes were not good. This showed that those events that occurred outside of a hospital had worse maternal and neonatal outcomes. Vanden Hoek et al. recommended the activation of perimortem caesarean section preparation as soon as a cardiac arrest in a pregnant woman is identified, regardless of fetal viability. Delivery of the fetus, either alive or dead, improves maternal venous return and increases the chance of successful maternal resuscitation [12].

In late pregnancy, the effectiveness of CPR is compromised by aorto-caval compression limiting venous return to the heart. Delivery of the fetus causes immediate relief of the aorto-caval compression and thus increases maternal venous return and cardiac output [13]. Katz et al. reported a profound improvement in twelve of the women after they underwent a perimortem caesarean section [3]. These patients should be placed in the left lateral position to maximize blood return to the heart. CPR must be continued throughout the caesarean section to maintain blood flow and after delivery. This increases the chance of a successful maternal and neonatal outcome [5,7,14,21].

The causes of trauma in pregnancy include motor vehicle accidents, falls, assaults, homicides, domestic violence and penetrating wounds [15]. Whitten et al summarized the cases of perimortem and postmortem caesarean sections between 1970 and 1996. The most common reason for PMCS was a road traffic accident. During this period, 56 postmortem caesarean sections were reported. Only 6 babies survived with normal neurological development (survival rate of 10.7%) and 8 infant were born alive but died within the early neonatal period. Despite the rarity of these cases, the authors highlight the need for guidelines to answer the question "Should an attempt be made to save the baby by caesarean section?" [1]. Although the outcomes remained poor, since the introduction of The Managing Obstetric Emergencies and Trauma (MOET) course in 2004, the use of PMCS by clinicians has increased. Reported maternal case fatality rate was 83% and neonatal case fatality rate was 58 % [16]. Recent data from the 2003–2005 triennium suggest that neonatal outcomes are improved. CEMACH reported 49 women who underwent a perimortem caesarean section, 20 out of 52 babies survived [17]. Katz et al reviewed cases of postmortem caesarean between 1900 and 1985, 93% of survived infants were born within 15 minutes and 70% within 5 minutes. They suggested that the infant survival rate is related to the interval between cardiac arrest and delivery [4]. In a review of all published cases from 1985 to 2004, they reported 38 perimortem caesarean sections from which 34 infants of

28 women (3 sets of twins, 1 set of triplets) survived. Time of delivery after maternal cardiac arrest was available for 25. Eleven infants were delivered within 5 minutes, 4 were delivered from 6 to 10 minutes, 2 were delivered from 11 to 15 minutes, and 7 were delivered more than 15 minutes. The neurological outcomes were better among infants born within 5 minutes of the cardiac arrest. These results supported their previously suggestion to perform a perimortem section within 4 minutes of maternal cardiac arrest if resuscitation is ineffective [3,4].

Our 1st case was diagnosed at stage 3 of Sarnat hypoxic-ischemic encephalopathy classification. The mortality rate in severe hypoxic-ischemic encephalopathy is 25–50%. Most deaths occur in the first week of life due to multiple organ failure. Survived infants with severe neurologic disabilities die in their infancy from aspiration pneumonia or systemic infections [18]. Our baby was delivered 45 minutes after maternal injuries. She survived with neurological sequels and had difficulties with feeding, at 2nd month she underwent an operation and feed via gastrostomy tube. PMCS in our 2nd case was performed within 15 minutes. The baby was born at 31 weeks of gestation and complications related to prematurity were observed. The respiratory distress syndrome (RDS) is a life-threatening complication of preterm birth. Drugs such as antenatal steroids enhance lung maturity and can prevent severity of RDS in preterm babies between 24 and 34 weeks of gestation. In our 2nd case due to emergency delivery antenatal steroid was not given, and symptoms of RDS appeared. Hepatic subcapsular hematomas are relatively common lesions and may be life-threatening. Trauma is one of the conditions associated with these hematomas. In our case sepsis, intracranial hemorrhage and coagulopathy were excluded. Maternal trauma, prematurity, hypoxia and resuscitation were thought as possible causes of hepatic hematomas. Despite all complications the baby was discharged at 45th days and did not showed any neurological disturbance at follow-up. Lopez-Zeno et al reported a case of maternal injury by gunshot wound; the baby was delivered 47 minutes after maternal injury and 22 minutes after documented maternal cardiac arrest. Neonatal follow-up at 18 months of age demonstrated a neurologically normal infant [19]. A PMCS section, resulting in fetal survival, performed after 45 minutes of maternal CPR is reported in a patient with multiple penetrating injuries [20]. Capobianco et al described successful resuscitation of baby 30 minutes after the death of the woman jumped from a fourth-floor window of the labor ward [22].

Conclusion

Continued CPR after maternal cardiac arrest and the time interval between maternal cardiac arrest and delivery represent important determinants of fetal and maternal survival. Well-trained teams in the performance of neonatal resuscitation and staff with additional training of obstetric emergency should be involved in resuscitation.

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