



Case Report

Live birth after perimortem cesarean delivery in a 36-year-old out-of-hospital cardiac arrest nulliparous woman

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ABSTRACT

Objective: The aim of this study is to share a valuable experience of perimortem Cesarean delivery (PMCD) when no signs of spontaneous circulation were detected after 4 min of resuscitation. The time interval between maternal cardiac arrest and neonatal delivery was evaluated and reviewed.

Case report: We present the case of an out-of-hospital cardiac arrest (OHCA) in a nulliparous woman who survived a car accident with only seatbelt injuries. The term infant was delivered by PMCD at our emergency department at least 43 min after maternal cardiac arrest. The mother only had concussion and was healthy at the time of discharge. The infant survived but had moderate neurological growth impairment (cerebral palsy) at the age of 7 months.

Conclusion: Contrary to previous studies and case reports, maternal and neonatal outcomes seem to be better when performing PMCD within 10 min. Multidisciplinary teamwork is the key for optimal outcomes in such situations.

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Introduction

Maternal cardiopulmonary arrest (MCPA) is a rare event, with an incidence of approximately 1/12,500 to 1/30,000 deliveries. MCPA is also a catastrophic event which can cause significant maternal and neonatal morbidity and mortality. Decision-making around the timing and place of delivery, investigations and intensive care management can be challenging. Cesarean delivery after maternal cardiac arrest is called perimortem cesarean delivery (PMCD). The American Heart Association recommends that PMCD should be initiated after 4 min of failure of resuscitative efforts with a goal of delivery within 5 min (the 4- to 5-min rule) of initiation of resuscitative efforts [1]. Therefore, a well-prepared, multidisciplinary team is necessary to perform basic and advanced cardiac life support specific to the anatomic and physiologic changes of pregnancy. Herein, we represent the case of a nulliparous term woman who had OHCA without severe injury after a vehicle accident, who subsequently underwent PMCD at out emergency department.

Case report

A 36-year-old nulliparous woman had an OHCA at 38 + 4 weeks of gestational age and was brought to the Emergency Department of Mackay Memorial Hospital (MMHED) after a vehicle accident. She had received regular prenatal care at Taiwan Adventist Hospital. Routine prenatal screening tests were all normal, and she did not have any systemic diseases. According to the emergency medical technician (EMT), she was driving by herself with her seatbelt fastened when she crashed into a truck. She was found in cardiac arrest and cardiopulmonary resuscitation (CPR) and automated external defibrillation (AED) were performed at the scene. She had return of spontaneous circulation (ROSC) after the first CPR attempt, but went into cardiac arrest for the second time on the way to MMHED. The total duration of CPR was about 16 min. On arrival at MMHED, she was unconscious, with a Glasgow Coma Scale (GCS) score of E1V1M1. Her body temperature was 37.5 °C, blood pressure 135/101 mmHg, pulse 145 beats per minute and respiratory rate 12 beats per minutes. Her pupils were 8 mm in diameter and she had no light reflex. She had only minor superficial abrasion wounds consistent with seatbelt injuries.

She was intubated immediately after arriving at MMHED, and obstetricians were called for emergency prenatal evaluation. Initial

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obstetrical ultrasound showed a viable baby with fetal bradycardia of 70–80 beats per minute. However, her pulse rate suddenly fell to 40 to 50 beats per minute, and Atropine 0.5 cc was given. Due to her unstable condition and fetal distress, she underwent immediate PMCD on the spot. An asphyxia male baby was delivered within 1 min, with a body weight of 2920 g and body length of 52 cm. The 1-min and 5-min Apgar scores were 0 and 5, respectively. The newborn received neonatal resuscitation and emergency intubation immediately after delivery and was then admitted to the neonatal intensive care unit (NICU).

During PMCD, a postpartum hemorrhage caused by uterine atony and disseminated intravascular coagulation (DIC) were noted. She received intravenous and intrauterine injections of oxytocin with uterine massage for uterine atony. She also received blood transfusion with whole blood, packed RBC, platelet and fresh frozen plasma for disseminated intravascular coagulation. After hemostasis was well-controlled, we closed the wound layer by layer.

After PMCD, her GCS score was E1VtM1, and her pupils were still dilated (7 mm) without light reflex. Under the suspicion of brain damage, she underwent emergency brain computed tomography (CT), which revealed no intracranial hemorrhage (ICH). She regained consciousness after CT, with a GCS score of E3VtM5 and both pupil sizes of 3 mm with light reflex. After emergency examinations and management, she became more stable and was transferred to a surgical intensive care unit (SICU) for close monitoring. Two days after delivery, the endotracheal tube was removed. She was treated in the SICU for 3 days, and was closely monitored in a general ward for 8 days. She had no major sequelae except for concussion with short-term memory loss and multiple chest abrasion wounds consistent with seatbelt injuries.

With regard to the male newborn, his initial Apgar score were 0 and 5 at 1 min and 5 min, respectively. He received cardiopulmonary resuscitation for 1 min at MMHED by pediatricians and resumed ROSC. After admission to the Neonatal intensive care unit (NICU), he received therapeutic hypothermia treatment for 72 h and erythropoietin transfusion to minimize hypoxic-ischemic encephalopathy. He was treated in the NICU for 46 days. Brain magnetic resonance imaging (MRI) revealed symmetric small areas of high signal intensities in bilateral lentiform nuclei, which were associated with post hypoxic-ischemic changes. He was diagnosed with cerebral palsy. He is currently 7 months old and undergoing rehabilitation at a pediatric neurologic clinic.

Discussion

Cardiac arrest in pregnancy is a rare event but one of the most challenging clinical scenarios. The incidence of MCPA has been reported to range from 1/12,500 to 1/30,000 deliveries with a maternal survival rates of 17–59%, fetal survival rates of 61–80% and approximately 88–100% of surviving neonates neurologically intact [2]. Although most protocols of resuscitating a pregnant woman are similar to those of a standard adult, several aspects and considerations are unique. The main difference is that resuscitation involves two patients at one time, the mother and fetus. Knowledge deficits and poor resuscitation skills can lead to poor maternal and fetal outcomes.

During pregnancy, all aspects of the physiology of the mother change. Therefore, the recommendations of the American Heart Association, Society for Obstetric Anesthesia and Perinatology, and European Resuscitation Council are similar for the management of MCPA, and can be summarized as follows [2]:

- Step 1: Rapid assessment of gestational age based on the fundal height. Gestational age should be considered over 20

weeks if the uterus is palpable at the level of the umbilicus or above, which may result in aortocaval compression.

- Step 2: Displacement of the gravid uterus to the left side through either manual one-hand or two-hand left uterine displacement (LUD) (Fig. 1) to relieve aortocaval compression to make resuscitation more effective.
- Step 3: Immediate initiation of basic life resuscitative efforts (airway and circulatory support) and transition to advanced cardiac life support (ACLS), inclusive of defibrillation or ACLS medication if skilled providers are available.
- Step 4: Performing PMCD at 4 min to allow for a resuscitative delivery within 5 min if initial maternal resuscitation attempts are unsuccessful. The other purpose of timely PMCD is to decrease the risk of neonatal neurological damage.
- Step 5: Evaluation of the primary etiology of maternal cardiopulmonary arrest.

In the current report, we shared a case of favorable outcomes associated with PMCD. When the unconscious pregnant woman was brought to our emergency department, her fundal height was five finger-breadths above the umbilicus. To improve her hemodynamic status, we decided to perform PMCD as soon as possible. As mentioned above, the current guidelines recommend commencing PMCD at 4 min and completing delivery by 5 min to achieve maternal resuscitation and optimize fetal outcomes. However, from a practical perspective, many authors have stressed the difficulties in accomplishing delivery within 5 min. In our case, the duration from the transport by the EMT to delivery of the fetus was about 20 min.

With regards to the outcomes of PMCD, Katz and colleagues [3] conducted a review of all reported maternal and fetal outcomes in 1986, which led to the widespread adoption of the 4- to 5-min rule in training curricula. Katz and colleagues [4] subsequently updated the review of all published cases from 1985 to 2004 and reported 38 cases of PMCD and 12 of 20 women with ROSC immediately after delivery. Twenty-eight of the 38 cases of PMCD (74%) resulted in viable neonates, but only eight of the 38 cases met the recommended '4 min' timeframe for the commencement of the cesarean section. The neurological outcomes appeared to be better among the infants delivered within 5 min after maternal cardiac arrest. In addition, Einav and colleagues [5] conducted a 30-year review of all reported cases of maternal cardiac arrests occurring prior to a cesarean section from 1980 to 2010, and reported that 60.6% of the mothers achieved ROSC, and that 51 of 94 mothers (54.3%) survived to hospital discharge. In addition, perimortem cesarean section was beneficial in 31.7% of the cases, with no reported ill effects. Only 7%

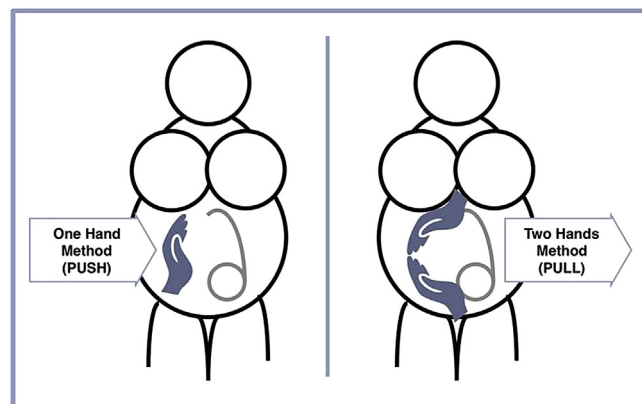


Fig. 1. Manual one-hand or two-hand left uterine displacement.

Table 1

Reported cases of maternal and neonatal survival rates with perimortem cesarean deliveries.

Authors	Survival rate		Received PMCD	4-to-5-minute rule	
	Mother	Neonate			
Rose et al. (2015) [2]	(17–59%)	(61–80%)	—	—	—
Katz et al. (2005) [4]	20/38 (52.6%)	34/38(twin*3,triplet*1) (89.4%)	38/38	<5 min: 11/34 neonates 6–10 min: 4/34 11–15 min: 2/34 >15 min: 7/34 Unknown: 10/34	
Einav et al. (2012) [5]	51/94 (54.3%)	42/66 (63.6%)	76/94	<5 min: 4/57 <10 min: 18/57 <15 min: 32/57	
Dijkman et al. (2010) [6]	8/55 (15%)	5/55 (9%)	12/55	IHCA	OHCA
				<5 min: 0	<5 min: 0
				5–15 min: 3	5–15 min: 1
				16–30 min: 4	16–30 min: 1
				>31 min: 1	>31 min: 2
Beckett et al. (2017) [7]	38/66 (57.6%)	46/58 (79.3%)	49/66	<5 min: 30/49 ≥5 min: 17/49 Unknown: 2/49	

of the patients received PMCD within 5 min and in-hospital cardiac arrest (IHCA) followed by PMCD within 10 min seemed to be associated with better maternal outcomes. Moreover, neonatal outcomes were better with an earlier delivery time. Dijkman and colleagues reported a maternal mortality rate of 83% and neonatal mortality rate of 58% between 1993 and 2008 in the Netherlands. In their study, 55 women had a cardiac arrest, of whom, 12 underwent PMCD, none of which were performed within 5 min. Of these 12 women, four had OHCA and none of the mothers or neonates survived. The other eight women had IHCA and five neonates survived after being born within half an hour of the maternal cardiac arrest [6]. Beckett and colleagues published a 3-year prospective and descriptive cardiac arrest in pregnancy study (CAPS) in the UK, in which 66 pregnant women had cardiac arrests of whom 49 underwent perimortem cesarean section. Twenty-four of 25 babies survived (96%) when PMCD was performed within 5 min compared with 7 of 10 babies (70%) when PMCD was performed more than 5 min after the cardiac arrest. The time from collapse to PMCD was significantly shorter in the woman and babies who survived (median interval 3 versus 12 min) [6]. With regards to our case, we performed PMCD at least 43 min after maternal cardiac arrest. The mother was admitted for 10 days and was generally healthy at the time of discharge. The neonate survived but had impaired neurological function. The boy is currently 7 months old and continues rehabilitation, and we will follow up his long-term development.

In summary, cardiac arrest in a pregnant woman is a rare but devastating event. Our case of PMCD was associated with good maternal and neonatal outcomes, which is likely due to the combination of training and practice drills in our multidisciplinary team, including EMT, emergency medicine specialists, traumatologists, obstetricians, pediatricians, anesthesiologists and nurses. No randomized-controlled trials on the management of cardiac arrest

in pregnancy have been published and current guidelines are based on a few case studies and expert opinion (Table 1). The most recent AHA guidelines for cardiac arrest in pregnancy were published in 2010 and updated in 2015. In order to improve maternal and neonatal prognosis, we recommend that all centers have perimortem cesarean packs readily available, with additional training of associated medical staff and protocols to deal with such emergency situations immediately. The quicker PMCD is performed, the better the maternal and neonatal outcomes.

Conflicts of interest

The authors have no conflicts of interest relevant to this article.

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