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Case report: We reported the outcomes of three cases of perimortem caesarean delivery secondary to maternal cardiac arrest. A 28-year-old G3P2 at 36 weeks of gestation who developed severe hypoxaemia secondary to acute pulmonary oedema which was arise from pre-eclampsia related hypertensive crisis.The second case was a 29-year-old G1P0 at 38 weeks of gestation who developed severe hypoxaemia secondary to spinal anaesthesia complication (total spinal)and the third case was a 44-year-old G5P4 at 39 weeks of gestation who developed severe hypoxaemia secondary to failed intubation and ventilation during induction of anaesthesia. Observing the outcomes of the three maternal after post perimortem caesarean delivery, we are strongly agreed that the time from maternal cardiac arrest to the initiation of resuscitative hysterotomy should be shifted from 4 minute to immediately.

Conclusion: Preparations for perimortem caesarean delivery should be made simultaneously with the initiation of maternal resuscitative efforts.

Keywords: *perimortem caesarean delivery, resuscitative hysterotomy, maternal cardiac arrest.*

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4 Minutes Rule in Perimortem Caesarean Delivery: Does it Still Relevant? Case Series

Abdul Karim Othman [α], Mohd Nazri Ali [σ], Wan Nasrudin Wan Ismail [ρ], Nurul Aimi Mustaffa [ω] & Mohd Habibullah Zakaria [¥]

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I. Introduction

Perimortem caesarean delivery (PMCD), or so called resuscitative hysterotomy is a hysterotomy procedure performed to resuscitate a maternal in the middle or late period of gestations who has entered cardiac arrest for any reason. This procedure is recommended to be initiated for two important reasons that is to maximize the maternal response to resuscitation during cardiopulmonary resuscitation and to save the life of the viable foetus. The theory behind perimortem caesarean delivery procedure is that effective cardiopulmonary resuscitation is extremely difficult in maternal at middle to late period of gestations due to the gravid uterus. It was reported that the chest compression in a maternal with a gravid uterus will only leads in the best of circumstances to a cardiac output of 10% of the normal cardiac output[1]. Therefore, by emptying the gravid uterus early enough and with the support of high-quality cardiopulmonary resuscitation, we believe that the outcome of the arrested maternal and the viable foetus will be improved significantly and probably we can reduce the neurological damage to the survived maternal.

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II. Cases

Case 1.

A 28 years old G3P2 at 36 weeks of gestation developed severe hypoxaemia secondary to acute pulmonary oedema which was arise from pre-eclampsia related hypertensive crisis. As the patient developed cardiac arrest, perimortem caesarean delivery was attempted after failed to regain the return of spontaneous circulation (ROSC) despite 10 minutes duration of high-quality cardiopulmonary resuscitation. The baby was discharged home at Day 3 of life with no neurological deficit. The mother was discharged home with no neurological deficit on the 25th day of PMCD having an occipital lacunar infarct.

Case 2.

A 27 years old G1P0 at 39 weeks of gestation with maternal obesity (BMI of 32kg/m^2) developed severe hypoxaemia secondary to spinal anaesthesia complication (total spinal). As the patient developed cardiac arrest, perimortem caesarean delivery was attempted after failed to regain the return of spontaneous circulation (ROSC) despite 10 minutes duration of high-quality cardiopulmonary resuscitation. The baby was discharged home at Day 3 of life with no neurological deficit. However, the mother was discharged home on the 198th day of PMCD with severe neurological deficit secondary to global hypoxic ischaemic brain injury.

Case 3.

A 42 years old G5P4 at 38 weeks of gestation with gestational diabetes and one previous caesarean delivery developed severe hypoxaemia secondary to failed ventilation and intubation during induction of anaesthesia. As the patient developed cardiac arrest, perimortem caesarean delivery was attempted after failed to regain the return of spontaneous circulation (ROSC) despite 3 minutes duration of high-quality cardiopulmonary resuscitation. The baby was discharged home with no neurological deficit. However, the mother was discharged home on the 44th day of PMCD with a severe neurological deficit secondary to global hypoxic ischaemic brain injury.

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In Table 1we describe the durations (in minutes) for each significant step from the time of maternal cardiac arrest to the initiation of perimortem caesarean delivery and duration for achieving the return of spontaneous circulation to the arrested maternal.

Table 1: Duration (minutes) for each step during Perimortem Caesarean Delivery until ROSC

	Case1	Case 2	Case 3
Location of cardiac arrest	Operation theatre	Operation theatre	Operation theatre
Durationfrom cardiac arrest to initiation of CPR	Immediate	3 minutes	Immediate
Duration from CPR to initiation of PMCD	10 minutes	10 minutes	3 minutes
Duration from skin incision to delivery of the foetus	Less than 3 minutes	10 minutes	7 minutes
Duration from delivery of the foetus to maternal ROSC	Less than 2 minutes	Less than 2 minutes	5 minutes
Total duration from cardiac arrest to ROSC	15 minutes	15 minutes	25 minutes

III. Discussion

4-minutes rule in perimortem caesarean delivery requested that the resuscitative hysterotomy procedure should be initiated within 4 minutes of maternal cardiopulmonary arrest if the resuscitative efforts were unsuccessful [2]. This is due to the traditional believed that adults begin experiencing anoxic brain damage 4 to 6 minutes into a cardiac arrest. However, this assumption has raised an important immediate question especially in resuscitating pregnant women in the late period of gestations.

Pregnant women in the third trimester are actually not very comparable to "adults" in the physiology of resuscitation: high oxygen consumption with overall high metabolic rate, reduced oxygen reserve with faster tendency to develop hypercapnia and hypoxaemia, high percentage of cardiac output being directed to the uteroplacental circulation[3] and these factors are further aggravated by a significant reduced efficacy of chest compressions during cardiopulmonary resuscitation and completely obstructed vena cava by the gravid uterus. Therefore, the four-minutes rule cut-off for anoxic brain injury may not be applicable to this population as it is applying to non-pregnant patients. We would expect that pregnant women with gravid uterus to be even more susceptible to oxygen deprivation than the non-pregnant adults who experienced ischemic brain injury in as early as 4 minutes. Furthermore, there is a major hemodynamic fluid shifts occur at birth including a significant increase in venous return following the relief of the vena cava compressions, and redirection of the circulating blood from the uterine to the systemic circulation[4].

Looking at the outcome of the maternal in our case series, we are strongly agreed with Rose et al which suggest that if the uterus is palpable at or above the umbilicus, preparations for delivery should be made simultaneously with the initiation of maternal resuscitative efforts; and if maternal condition is not rapidly reversible, resuscitative hysterotomy with delivery should be performed regardless of foetal viability or elapsed time since maternal cardiac arrest[5]. In addition to this, it is important to note that of all the reversible causes cited for maternal cardiac arrest by the American Heart Association, many are absolute indications for prompt delivery of the fetal[6].

IV. Conclusion

The decision to resuscitative hysterotomy should be made around the cardiac arrest, and it's should not be delayed, as both maternal and foetal chances of survival are expected to decline significantly with time and therefore, the time from maternal cardiac arrest to initiation of resuscitative hysterotomy should be shifted from 4 minute to immediately.

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Compliance with ethics guidelines

Abdul Karim Othman, Mohd Nazri Ali, Wan Nasrudin Wan Ismail, Nurul Aimi Mustaffa and Mohd Habibullah Zakaria declare that they have no conflict of interest. Patient anonymity was preserved, and this article does not contain any studies with animal subjects performed by any of the authors.

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