ORIGINAL ARTICLE

Maternal Resuscitation - Role of Perimortem Cesarean Delivery (PMCD)

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ABSTRACT

Background: This study was undertaken to address the topic which evokes mixed reactions from the medical professionals and patients and their relatives. There is no local data, even retrospective available on this very important aspect of cardiopulmonary resuscitation. A pregnant collapsed patient requires special considerations and adjustments for cardiopulmonary resuscitation and this study highlights the assessment of data of this very rare condition which involves two patients' mother and fetus.

Aim: To determine the causes and outcome of maternal cardiac arrest and relation of perimortem cesarean section timing with maternal and fetal outcome.

Study design: retrospective case series.

Place and duration: Multicentre data for the study was collected from January 2010-December 2015 from Pakistan Naval Hospital Shifa, Combined Military Hospital Kharian and Armed Forces Institute of Cardiology/ National Institute of Heart Disease Rawalpindi Pakistan.

Methodology: Hospital records of consecutive pregnant patients diagnosed with cardiac arrest were evaluated retrospectively. Primary outcome was maternal and neonatal survival. Secondary outcome was timing of Perimortem cesarean section including arrest to delivery time and relation to survival.

Results: A total of 15 patients were identified from hospital records. Mean age was 34.4± 5.2 yrs period of gestation at time of arrest 35.3±2.0 weeks. Majority of patients were unbooked 10(66.6%) and place of arrest was labor room 6(40%), ward 4(26.7%), intensive care unit 3(20%) and emergency room 2(13.3%) respectively. Maternal survival was in 4(26.7%) and 5(35%) neonates survived. Relation between timing of PMCS and maternal and neonatal survival was statistically significant .P value 0.035 and 0.0.05 for maternal and neonatal survival.

Conclusion: maternal cardiopulmonary arrest is a rare occurrence but involves intense emotions both for the victim's family as well as the team providing care. Resuscitation guidelines and necessary equipment for performing PMCD should be available at all emergency departments and labor wards.

Key words: Maternal collapse, perimortem cesarean section, cardiopulmonary resuscitation

INTRODUCTION

Maternal cardiopulmonary arrest is rare reportedly occurring 1 in 30,000 pregnancies but carries devastating consequences.[1] Cardiac arrest management protocols kept on evolving, but the efficacy of implementing these strategies in pregnant patient's cardiac arrest remained unknown. Due to extreme rarity and highly uncontrolled circumstances of cardiopulmonary arrest during pregnancy, study of this medical situation is very difficult. Modern cardiopulmonary resuscitation (CPR) was first introduced in 1961.[2] Obstetric resuscitation first appeared in the guidelines only 30 years later [3] but less than a page was dedicated to the subject. Now current American Heart Association (AHA) resuscitation guidelines[4,5] and UK based Royal College of Obstetricians and Gynecologists first green top guidelines on maternal collapse in pregnancy[6] has generated interest in this special situation. There is growing awareness that the physiological and anatomical changes of pregnancy necessitate modification of standard practice of cardiopulmonary resuscitation. Both resuscitation and obstetric guidelines suggest that perimortem caesarean delivery be considered within 4 min of maternal collapse if no return of spontaneous circulation (ROSC) despite effective resuscitation[5,6]. Delivery within 5 min in women beyond 20 weeks of gestation is endorsed to facilitate maternal resuscitation and not for fetal salvage, as the baby has best chance of survival if mother survives. The 4 min interval theoretically benefits both mother and neonate by improving maternal hemodynamics thus minimizing ischemic neurological damage in both[1].

Case reports of perimortem cesarean delivery (PMCD), successfully saving the fetus started appearing in literature during 19th and 20th century, and the procedure began to be seriously considered

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as a legitimate medical intervention when all other resuscitative measures failed[7].

During the 1980s, many authors reported unexpected maternal recoveries after postmortem cesarean deliveries. This led to the possibility that PMCD might actually improve a mother's chance of survival during a collapse rather than harming her[8,9]. Managing a maternal cardiac arrest is an extremely challenging and trying task for emergency department staff as there are two concerns, the mother and the fetus. Since out-of hospital cardiac arrests carry the worst outcomes, emergency medical services also play a central part in the management process. There are reports of PMCD being done in vehicles en route to hospital with good outcome[10]. At an arrest scenario some factors should be taken into account. Not only is providing high quality CPR the only consideration but the recommended modifications in a pregnant patient should be adapted like left uterine displacement, chest compressions high on sternum and PMCD if pregnancy is more than 20 weeks or fundal height is above the level of umbilicus if gestation is not known. The available evidence strongly supports best outcome if PMCD is done within five minutes of arrest. As it is emergency procedure consent is not required[5]. The delivery should be performed by the present physician at the site of arrest with the most surgical experience, preferably an obstetrician or surgeon depending on availability. CPR measures should continue during the delivery and not interrupted for shifting the patient. At the same time all these considerations should not delay delivery as delayed decision-making may lead to unjustified prolongation of the time thus compromising mother and fetus both[6]. We present in this case series the outcome of patients who had cardiac arrest in hospital and the subsequent management they received.

METHODOLOGY

This was a case series done in Pakistan Naval Hospital Shifa, Combined Military Hospital Kharian and Armed Forces Institute of Cardiology Rawalpindi from Jan 2010-dec 2015. All consecutive pregnant patients diagnosed with cardiac arrest were evaluated retrospectively from the hospital records. Cardiac arrest was identified by report of treatment with chest compressions, ACLS (Advanced cardiac life support) provision or non perfusion rhythm on cardiac monitoring. Patients less than 20 weeks, out of hospital cardiac arrest and maternal return of spontaneous circulation (ROSC) within 4 minutes were the exclusion criteria. Primary outcome was defined as maternal and neonatal survival. Secondary outcome was care provided like resuscitation according to guidelines, peri mortem cesarean section including arrest to delivery time. Peri-mortem cesarean section(PMCS) was cesarean delivery performed after initiation of cardiopulmonary resuscitation. Data was collected and analyzed using SPSS version 21.Continous variables maternal age, parity, gestational age, time from arrest to delivery were described as mean± SD. Categorical variables including cause of arrest, location of arrest, presenting maternal rhythm, maternal and fetal survival was expressed in percentage. Chi square test was applied to see association of timing of PMCS with maternal and neonatal survival and a P value of 0.05 was considered significant.

RESULTS

A total of 15 patients were identified from hospital records. Demographic profile of the patients is shown in table 1. Majority of patients was unbooked 10(66.6%). Place of cardiac arrest was labor room 6(40%), ward 4(26.7%), intensive care unit 3(20%) and emergency room 2(13.3%) respectively. Apparent cause of arrest and presenting rhythm at arrest is shown in Table 2.Resucitation was started according to American Heart Association Guidelines in all 15(100%) patients. Peri-mortem cesarean section was done in all patients but one patient is excluded from calculation of PMCS association with neonatal and maternal survival statistics as record of arrest to PMCS timing was incomplete. Maternal survival was in 4(26.7%) and 5(35%) neonates survived. Association between interval before PMCS and maternal and neonatal survival was statistically significant P value 0.035 and 0.0.05 for maternal and neonatal survival respectively. None of the PMCS was done in the recommended five minute window but even then mothers and babies survived. The four patients who survived were in the record of last two years as the understanding of role of PMCS is disseminated and adaptations in guidelines for pregnant patients are understood including role of timely PMCS in maternal interest.

Table 1: Demographic profile (n=15)

Maternal characteristics	**Values**
Mean Age (Mean ± SD) in years	34.4±5.2
Mean date of gestation (Mean±SD) in weeks	35.33±2.02
Mean interval before PMCS (Mean±SD) in minutes	19.07±6.1
Parity P1 P2 P3 P4	 1 (6.7%) 6(40%) 5(33.3%) 3(20%)

Table 2: characteristics of maternal cardiac arrest

Cause of arrest	n	Rhythm at arrest	n
Myocardial infarction	1(6.7%)	Myocardial ischemia	1(6.7%)
Embolism	5(33.3%)	Asystole	5(33.3%)
Epidural	1(6.7%)	Pulse less electrical activity	1(6.7%)
Eclampsia	2(13.3%)	Ventricular fibrillation	6(40%)
Abruption	1(6.7%)	Un documented	2(13.3%)
Cardio-myopathy	2(13.3%)		
Arrhythmias	3(20%)		

Table 3: Association between Interval before PMCS and maternal and neonatal outcomes

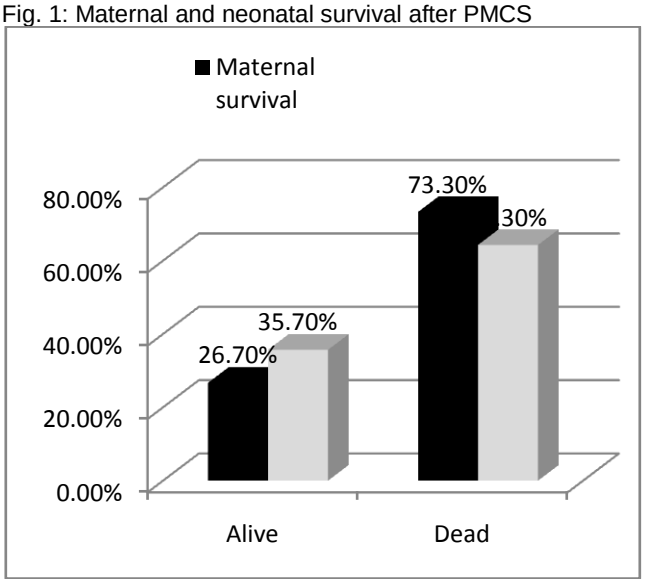
Maternal Outcome	Mean interval before PMCS
Alive (n=4)	13.75±4.7 minutes
Dead (n=10)	21.2±5.4 minutes

P value 0.035

Neonatal Outcome	Mean interval before PMCS
Alive (n=5)	15±5.7 minutes
Dead (n=9)	21.3±5.0 minutes

P value 0.05

Fig. 1: Maternal and neonatal survival after PMCS



DISCUSSION

Maternal cardiac arrest is a very challenging situation and PMCS done at appropriate time is life saving. Providing true estimates of maternal and neonatal outcomes from peri mortem cesarean delivery (PMCD) is difficult at present due to paucity of data. The literature primarily contains case reports and very small series like ours. Before 1986 only 188 PMCDs had been reported. A case review of the data reported between 1986 and 2004 revealed only 38 additional case reports[11]. Review of these revealed that the most common causes of maternal arrest included trauma, pulmonary embolism, cardiac causes, sepsis, and eclampsia[12] whereas embolism was the main cause in this study followed by cardiac diseases. The dominant cardiac rhythm at the time of arrest was ventricular fibrillation in 6(40%) followed by asystole in 5(33.3%) as compared to pulse less electrical activity in a review article[12].

The Confidential Enquiry into Maternal Deaths supports the concept of rapid delivery after arrest because the outcomes in the perimortem group were significantly better than those in the postmortem group. In 10 years, 40 perimortem deliveries were registered, of which 25 resulted in neurologically intact surviving infants (62.5%)[13] A review of all published cases of PMCD up to 2010 showed that PMCD led to a clear maternal survival benefit in 19 of 60 cases (31.7%), and there were no harmful effects. In-hospital arrest and PMCD within 10 min of arrest were associated with better maternal and neonatal outcomes p <0.05. Mean times from arrest to delivery were 14±11min and 22±13 min in survivors and non-survivors respectively[12] which is similar to results in this study. Neonatal survival was reported even when PMCD was done much after the recommended time .[11] In this study none of PMCS was performed within the recommended time frame. Earliest was performed 10 min after arrest and maximum delay was 35 minutes, but 35% neonates and 26.7% mothers survived. These data indicate that infant survival was seen when PMCD was performed well beyond 5 minutes after maternal arrest. Similar results are seen in a study by Jeejebhoy et al in which the time frame advocated for PMCD remained unmet in 93% of the cases, yet there was neonatal survival in 50% of cases, even when delivery occurred >10 min after the arrest.[11]In another study 12 out of 20 women had immediate ROSC after delivery and there were no cases of worsened maternal status after intervention. Despite the scarce data, PMCD infant survival rates as high as 70% related to expedited delivery of the infant have been reported .Also long term follow up data till 18 months after the event showed no neurological damage in studies[14].

The data from Katz et al support that maternal resuscitation improves as uterus is emptied and even if standard maternal resuscitative efforts have failed cesarean delivery is beneficial to both infant and mother.[15] To increase the likelihood of infant survival, the procedure should be performed as soon after maternal arrest as possible and at the place of arrest rather than wasting precious minutes in shifting the patient to operation theatre and also compromising

effective CPR during shifting[16]. A Study showed overall survival of 36.9% in pregnant women in whom CPR was done in emergency department[17]. There are reports of PMCS being done in vehicles by emergency medical personnel en route to hospital with good outcome as well[18]. Timing of PMCD and survival was statically significant like in our study [11]. High quality CPR was done in all patients but timely PMCS element was lacking in all our study patients. Limitation of this study is the small cohort and lack of long term data of the patients. The strength of this study is that it explores a concept which is new and challenging and will pave way for further research. Deciding when to deliver is crucial to maternal and neonatal survival but fixing specific time frames for PMCD is an area which needs to be explored further. Rather than burdening everyone with rigid time frames it may be more important to focus on event recognition and good overall performance by the available staff.

CONCLUSION

Maternal cardiac arrest is one of the most complicated arrest scenarios. Yet, since maternal arrest is such a rare event, preparations for maternal cardiac arrests are minimal and receive the least attention. Aim is to do Peri-mortem cesarean section within 5 minutes of cardiac arrest if resuscitation is ineffective in maternal interest. The emergency rooms should be prepared to handle this scenario with protocols in place. As PMCD is infrequently performed, emergency departments may not have a preselected pack of instruments or place for this procedure, however, most of the necessary items are readily available there .Practice drills and workshops should be carried out in all departments to better address the situation.

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Details of ethics approval: For this retrospective data analysis ethical committee approval was not required. Permission was taken from hospital administration for data collection ensuring patient's confidentiality.

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REFERENCES

1. Farida M. Jeejeebhoy et al.Cardiac Arrest in Pregnancy A Scientific Statement From the American Heart Association. *Circulation*. 2015;132:00-00. DOI: 10.1161/CIR.300.)
2. Safar P, Brown T, Holtey W, Wilder R. Ventilation and circulation with closed chest cardiac massage in man. JAMA 1961;176:574–6.
3. Guidelines for cardiopulmonary resuscitation and emergency cardiac care. Emergency Cardiac Care Committee and Subcommittees, American Heart Association,part IV: special resuscitation situations. JAMA 1992;268:2242–50.
4. Soar J, Perkins GD, Abbas G, et al. European Resuscitation Council Guidelines for Resuscitation 2010 Section 8. Cardiac arrest in special circumstances:electrolyte abnormalities, poisoning, drowning, accidental hypothermia,asthma, anaphylaxis, cardiac surgery, trauma, pregnancy, electrocution.Resuscitation 2010;81:1400–33.
5. 5.Vanden Hoek TL, Morrison LJ, Shuster M, et al. Part 12: cardiac arrest in special situations: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation 2010;122:S829–61 [Review].
6. RCOG. Maternal Collapse in Pregnancy and the Puerperium Green-top Guideline No. 56. January 2011. 24 p.
7. Cordero DR, Toffle RC, McCauley CS. Cardiopulmonary arrest in pregnancy: the role of caesarean section in the resuscitative protocol. W V Med J. 1992;88:402–3.
8. DePace NL, Betesh JS, Kotler MN. 'Postmortem' cesarean section with recovery of both mother and offspring. JAMA 1982;248:971–3.
9. Finegold H, Darwich A, Romeo R, Vallejo M, Ramanathan S. Successful resuscitation after maternal cardiac arrest by immediate cesarean section in the labor room. Anesthesiology 2002;96:1278.
10. 10. Kue R, Coyle C, Vaughan E, Restuccia M.Perimortem cesarean section in the helicopter EMS setting: a case report. Air Med J 2008;27:46–7.
11. Farida M. Jeejeebhoy1 and Laurie J.Morrison2.Maternal Cardiac Arrest: A Practical and Comprehensive Review Emergency Medicine International Volume 2013, Article ID 274814,8pageshttp://dx.doi.org/10.1155/2013/27484
12. 12.Einav S, et al. Maternal cardiac arrest and perimortem caesarean delivery: Evidence or ex-pertbased? Resuscitation (2012),http://dx.doi.org/10.1016/j.resuscitation.2012.05.005
13. Cantwell R, Clutton-Brock T, Cooper G, Dawson A, Drife J, Garrod D, Harper A, Hulbert D, Lucas S, McClure J, Millward-Sadler H, Neilson J, Nelson-Piercy C, Norman J, O'Herlihy C, Oates M, Shakespeare J,de Swiet M, Williamson C, Beale V, Knight M, Lennox C, Miller A,Parmar D,RogersJ,Springett A. Saving mothers' lives: reviewing maternal deaths to make motherhood safer: 2006–2008: the Eighth Report of the Confidential Enquiries Into Maternal Deaths in the United Kingdom [published correction appears in *BJOG*. 2014;122:e1]. *BJOG*.2011;118(suppl 1):1–203.
14. Katz VL, Dotters DJ, Droegemueller W. Perimortem caesarean delivery. Obstet Gynecol 1986;68:571–6.
15. Katz VL, Balderston K, DeFreest M. Perimortem caesarean delivery: were our assumptions correct? Am J Obstet Gynecol 2005;192:1916–21.
16. Parker J, Balis N, Chester S, Adey D. Cardiopulmonary arrest in pregnancy: successful resuscitation of mother and infant following immediate caesarean section in labour ward. Aust N Z J Obstet Gynaecol 1996;36:207–10.
17. Lavecchia M,Abenheim A H.Cardiopulmonary resuscitation of pregnant women in the emergency department June 2015Volume 91, Pages 104–107
18. Stehr SN, Liebich I, Kamin G, Koch T, Litz RJ. Closing the gap between decision and delivery – amniotic fluid embolism with severe cardiopulmonary and haemostatic complications with a good outcome.Resuscitation 2007;74:377–81.