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Prehospital perimortem caesarean section – a survivor

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Consent: Consent by the family has been provided for publication.

Abstract

Cardiac arrest in pregnancy is rare. It has a reported incidence of approximately 1 in 30000 pregnancies worldwide and occurs prehospitaly with rates of around 3 in every 100000 live births within the developed world. The management of maternal cardiac arrest is complicated by the anatomical and physiological changes of pregnancy, its rarity and clinician unfamiliarity. The presentation and the prehospital environment can make for an incredibly challenging, stressful and highly emotive scene. One aspect of maternal cardiac arrest management is the perimortem caesarean section, a surgical procedure that is potentially lifesaving for both mother and child. Although rarely reported in the field it is possible to successfully perform the procedure. This report details the emergent prehospital treatment of a 41-year-old woman pregnant with her first child of 30 weeks gestation. It describes a case of maternal cardiac arrest, her resuscitation and the undertaking of a prehospital perimortem caesarean section resulting in a neurologically intact infant survivor.
Keywords: Prehospital care, Perimortem caesarean section, Maternal resuscitation, Resuscitative hysterotomy

Introduction

Whilst globally maternal death is a significant issue, cardiac arrest in pregnancy in the developed world is known to be rare. British literature suggests an incidence of all cause cardiac arrest in pregnancy to be approximately 1 in 30000(1) with similar rates worldwide(2). The recent Cardiac Arrest in Pregnancy Study (CAPS) by Beckett and colleagues confirmed the United Kingdom incidence of 2.78 per 100000 maternities in the 2011-2014 triennium, the equivalent of 1 in 36000(3). In their study, analysis of the United Kingdom Obstetric Surveillance System (UKOSS) revealed a total of 66 patients experiencing cardiac arrest during pregnancy in the triennium, with a reported case fatality rate of 42%. Beckett et al report the movement of 11 patients from the community to hospital during the 3 years of the study with one patient dying during the prehospital care phase. Certainly, within the United Kingdom, conclusions can easily be drawn that if this data is extrapolated further, exposure to such a presentation is extremely rare for the prehospital practitioner. Analysis of the CAPS dataset reveals an incidence of maternal cardiac arrest in the community of the magnitude of approximately 1 in 200000 deliveries within the UK. Other rates of out of hospital maternal cardiac arrest are reported by France, 3 per 100000 live births(4) and Canada, 1.71 per 100000 pregnancies(5). It is proposed therefore to be reasonable to assume that no particular individual could ever obtain significant experience in the prehospital management of maternal cardiac arrest during their career. This report adds value in that it describes a neurologically intact survivor of a rare prehospital surgical event and specifically adds to the limited evidence for its use in the field. It shows that even when confronted with this rare presentation in the community swift surgical action may be lifesaving.
**Case Report**

A 41-year-old woman pregnant with her first child of 30 weeks gestation experienced a sudden collapse at home in the presence of family. She had no prior medical issues; pregnancy was proceeding uneventfully with no prenatal care concerns and no recent illness was apparent. A call was placed to emergency medical services (EMS) and bystander cardiopulmonary resuscitation attempted as advised by the emergency dispatcher. Immediate dispatch occurred of a double crewed ambulance and fast response vehicle containing a paramedic from the regional ambulance service. Additional activations included the resources of a local critical care doctor (EMICS, East Midlands Immediate Care Scheme) and air ambulance, transporting both a doctor and paramedic (HEMS, Helicopter Emergency Medical Service). At 9 minutes and arriving first on scene, the ambulance crew confirmed cardiac arrest with a presenting rhythm of ventricular fibrillation, basic life support was commenced and the patient defibrillated in a left tilt position. Arriving afterwards at 14 minutes post call the airway was secured by the critical care doctor via an endotracheal tube and intravenous access gained by the HEMS doctor. A further DC shock was delivered and the patient’s cardiac rhythm subsequently changed to asystole. A LUCAS (Lund University Cardiac Assist®, physio-control) device was placed for mechanical chest compressions and 0.9% saline administered intravenously along with adrenaline 1mg boluses as per current European Resuscitation Council guidelines. The decision to undertake perimortem caesarean section was taken and then performed immediately on the living room floor by the critical care doctor. A subxiphoid to pubis laparotomy was performed using scalpel and scissors and the uterus opened through a vertical uterine incision. Clear amniotic fluid was evacuated and
the female infant extracted from the uterus at 31 minutes post call to the EMS. The umbilical cord was clamped and cut to facilitate resuscitation. The baby was placed within a plastic bag and wrapped in towels for warmth and moved to the sofa for resuscitation. The total time to complete the surgical procedure was 4 minutes. The mother’s uterus was packed with CELOX™ (Medtrade products) gauze and pressure applied during resuscitation, there did not appear to be any evidence of haemorrhage. Maternal resuscitation was continued by the HEMS team but ceased at 68 minutes post EMS call due to futility. Immediately following delivery, the baby was unresponsive with no discernible heart rate or respiratory effort so 5 inflation breaths were provided by bag valve device. APGAR at 1 minute was 0 with CPR initiated. The critical care doctor intubated the infant with a 2.5mm uncuffed endotracheal tube to facilitate ventilation. Following this the baby quickly responded and within 3 minutes from birth had a heart rate of 160bpm and spontaneous respiratory effort. On moving to the ambulance spontaneous movement and good tone was exhibited, ventilation however at times required assistance. APGAR scoring taken at 5 minutes was 7 and 10 at 10 minutes.

Transfer to hospital was initiated by land ambulance with the critical care doctor at 43 minutes post EMS call with pre-alerts to the paediatric emergency department and neonatal teams. During the transfer the endotracheal tube was removed secondary to patient intolerance and adequate spontaneous respiration. The baby was placed within the doctor’s uniform for heat retention. The baby was handed over at 70 minutes post EMS call to the waiting consultant led team in good condition. Baby was taken to the local neonatal unit but electively intubated and ventilated for the administration of surfactant. Recovery was uneventful and baby quickly weaned from ventilation and extubated. Subsequent neonatal unit stay was uncomplicated and she was discharged from care to home. Post discharge follow up has remained normal and she remains neurologically intact nearly two years post-delivery, developing normally with no further medical follow up required. Post mortem
examination of the mother revealed that she died as a consequence of an undiagnosed cardiomyopathy.

Discussion

Prehospital literature

The true incidence of prehospital perimortem caesarean section is difficult to calculate. No recent mention of the incidence of prehospital perimortem caesarean section has been made in a large scale literature review(6). The prehospital literature is populated only by a few case reports on the subject of maternal cardiac arrest and perimortem caesarean section. In the United States Kupas and colleagues described the medical collapse of a grand multigravida from myocardial infarction, her subsequent resuscitation and in community perimortem caesarean section. In their 1998 case report not only did the mother die but the infant also experienced a severe neurological deficit(7). Similarly, the HEMS team of New South Wales described the resuscitation and death of a singleton mother with the withdrawal of care for her neonate due to severe hypoxic brain injury(8). In 2014 Gatti et al described a perimortem caesarean section in the community undertaken by an Italian Emergency Medical Services team (EMS) at the scene of a road vehicle collision. Following trauma resuscitation at the scene and during transportation the mother was declared deceased, the infant however in this case survived with only a small burden of neurological injury(9). The two successes described by Tommila et al of neonatal survival are noteworthy and have led the author to conclude that significant benefits may be attained by emergent prehospital perimortem caesarean section and go as far as to advise consideration of performing emergency hysterotomy in a case of prehospital maternal arrest(10).

Guidance
The use of perimortem section as an aid to the treatment of a pregnant woman in cardiac arrest has its roots deeply within the works of Katz over the last thirty years(11,12). The very tenet of which has been the evacuation of the gravid uterus to provide increased efficiency during resuscitation and thus survival advantage for the mother and in some cases the infant(12). Those that share Katz’s view describe the potential physiological gains of uterine evacuation with swift surgical intervention(13). In one review Einav concluded a resulting mortality benefit to approximately 31.7% of mothers, with an odds ratio for maternal survival for perimortem caesarean delivery of 7.42 for those delivered within ten minutes(6). However, most guidance on the management of maternal arrest and the use of perimortem section appears to be drawn directly from experiences of in hospital practice and is preoccupied by in hospital concerns. Notable guidance in maternal cardiac arrest management for hospital providers is published by the Royal College of Obstetricians and Gynaecologists within the United Kingdom(14) and the European Resuscitation Council(15). This may not be easily extrapolated to prehospital practice due to the lack of availability of specialised equipment and personnel in the field as well as the challenging clinical environment. More closely aligned with the concerns of the prehospital practitioner are the recommendations and practice guidance detailed by Parry et al(16) for use within the emergency department. Not only does Parry describe the perceived indications and contraindications for perimortem caesarean section but goes on to provide a simple management strategy and a practical guide to its provision.

Recognising the gap in guidance within the prehospital community in the United Kingdom Battaloglu and Porter published the results of a consensus meeting describing a number of key recommendations for prehospital practice(17). Of note they suggest performing the procedure in cases deemed to be over 20 weeks gestation, following correction of the possible causes of arrest, after four minutes of CPR, by a competent practitioner through a
vertical midline laparotomy incision. They conceded in their document however not only that the literature is not populated with high quality evidence on the subject but that their conclusions are based wholly upon very limited available literature and individual opinion.

**The procedure**

The technique is widely disseminated internationally through the MOET (Managing Obstetric Emergencies and Trauma course) produced by the Advanced Life Support group (ALSg). Dijkman and colleagues attribute the introduction of the MOET course in 2004 as directly contributing to the increasing use of perimortem section within the hospitals of Netherlands up to the year 2008(18). However, the lack of specialist assistance at times of emergency in the community is typical of prehospital care and thus it may fall upon the prehospital physician to undertake the procedure if confronted with a pregnant woman in cardiac arrest. The procedure itself, within the context of resuscitation, can be taught to non-surgical physicians to perform emergently. In 2014 on the subject of perimortem caesarean section the ALSg detailed that any professional with sufficient skills and understanding of the procedure could undertake it emergently but go on to stress that any professional without the skill should not be criticised for not proceeding even in an emergency(19). Currently within the UK the application of perimortem caesarean section by professionals other than physicians cannot be recommended. However medicolegal and professional regulatory considerations in other countries may differ.

Survival benefits have been attributed to conducting perimortem caesarean quickly in maternal cardiac arrest(3). Recognising timely delivery as a key factor in survival for both mother and baby has led to simulated in hospital studies concluding that delivery at the point of collapse is far superior in terms of avoiding time delays(20). Acknowledging this the 2015 American Heart Association scientific statement on maternal resuscitation recommends
performing the procedure at the site of maternal collapse(2). For the prehospital provider without the ability to perform perimortem caesarean section, rapid transportation to the closest capable receiving facility may be the only treatment option. However, recognition of the potential benefits to both mother and baby may encourage surgical intervention in the field if specialist assistance arrives.

The equipment required as recommended by van Dorp and colleagues(21) consists only of protective gloves, a scalpel, scissors and clamps. Such equipment could be made available to prehospital practitioners and lends itself directly to the prehospital environment. As opening the abdomen emergently has been seen as a source of time delay within hospital, having no requirement for specialised equipment has been seen as potentially lifesaving by some(22)

A midline laparotomy was used in this case to gain rapid access to the abdomen. This is a route to abdominal exposure recommended by some authors(17,20). In the prehospital field, undertaken by a practitioner unfamiliar with the procedure this may have its advantages. For example, this allows for the quick delineation of uterine anatomy and also provides exposure for haemorrhage control (compression or clamping of uterine and ovarian arteries or compression of the descending aorta) following uterine evacuation. Deflection of the bladder may be required to access the uterus in some cases, and then once able the uterus is incised either by a vertical or horizontal incision. In this case a vertical incision was undertaken for both rapidity of access and to avoid potential damage to the uterine vessels. The baby is then delivered through the defect and both mother and baby resuscitated according to guidance with attention to any active bleeding as a result of the procedure.

In any case, the rapid evacuation of the uterus produces its own problems, including the sudden presence of two patients requiring resuscitative care. This may overwhelm those on
scene and may create issues with competing resuscitative requirements and available resources, although this may be mitigated if either mother or baby is determined to be beyond help.

Although open to the non-surgical practitioner, performing perimortem caesarean section still mandates an understanding of the indications, appropriate anatomy and a knowledge to treat and control complications during its use. As it is unlikely that significant experience could be attained outside of hospital, in hospital sessions, training and simulation for the prehospital environment could be some routes to obtaining the necessary skills for this rare presentation.

Clinical governance is important and learning should be extrapolated and disseminated from these incidents. This may help any future health professional involved in a maternal cardiac arrest. As involvement in a case of maternal arrest may place a heavy psychological burden on the individual and teams in attendance any adverse effect of involvement should be mitigated at the earliest opportunity to the benefit of the attending clinician. Special attention should be paid to the needs of both families and friends of the patient who may be significantly traumatised.

**Conclusion**

Attending the pregnant woman in cardiac arrest is a rare and daunting prospect to prehospital providers. Within the United Kingdom the availability of prehospital trained physicians is increasing the chances of critical care provision at such incidents. Awareness of the presentation and acknowledgement of the advanced skills brought by physicians to scene may enable dispatchers to better target critical care resources to assist ambulance crews at these incidents. Recognition of the potential benefits to both mother and baby may then encourage surgical intervention in the field when this specialist assistance arrives. Thus, the presence of a prehospital practitioner able to undertake perimortem caesarean section at scene may
eliminate the significant delays inherent in transferring to suitable facilities from the community.

This article describes a maternal resuscitation and subsequent prehospital perimortem caesarean section resulting in a neurologically intact survivor. It is hoped that it may serve to provide prehospital clinicians presented with similar scenarios the courage to act swiftly to help preserve either maternal or infant life as in this case.

References


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