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Clinical paper

Liver lacerations as a complication of CPR during pregnancy☆,☆☆

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ABSTRACT

Aim: Cardiac arrest in peripartum patients is a rare but devastating event; reported rates in the literature range from 0.019% to 0.0085%. In the general population, a well-described complication of cardiopulmonary resuscitation (CPR), liver laceration and injury, is reported at a rate of between 0.5–2.9% after CPR. Liver laceration rate among peripartum patients receiving CPR has not been well-studied. We sought to find the rate of liver lacerations in the peripartum population associated with CPR, with the hypothesis that the rate would be higher than in the general population.
Methods: We identified pregnancies complicated by cardiac arrest by performing a retrospective medical record review from 2011 to 2016 at a single tertiary referral hospital. We then compared the rate of liver lacerations in this group to the rate in the general population as found in the literature.
Results: Eleven of 9408 women in the peripartum period suffered cardiac arrest. Return of spontaneous circulation occurred in seven of eleven (64%) women. Three of these seven women suffered clinically significant liver laceration (43%). Overall mortality rate among women suffering cardiac arrest was 82% (9/11).Even after return of spontaneous circulation, the mortality rate was 72%(5/7) including two of three women suffering liver laceration.
Conclusions: Based on a small retrospective study, liver lacerations requiring intervention occurred in 43% of gravidas patients that survived CPR, and is significantly higher than published rates (0.6–2.1%) for the general patient population. Further studies are indicated to determine the incidence of liver injury after peripartum CPR.

Introduction

Maternal cardiac arrest is a rare, frightening and devastating event, often resulting in the demise of the mother, fetus/neonate or both. The most common cause of maternal cardiac arrest is haemorrhage, accounting for up to 40% of all cases [1–3]. The reported rate of CPR among the peripartum population within developed countries ranges from 1:53,260 (0.019%) to 1:11,749 (0.0085%) [1–5].

Cardiopulmonary resuscitation (CPR) is an important intervention that has improved survival after cardiac arrest since being described almost 60 years ago [6]. Due to the physiologic changes that occur in pregnancy, guidelines for BLS/ACLS in the pregnant patient have been modified; for example, closed chest compressions are performed while manually displacing the gravid uterus to the left to alleviate compression of the vena cava and chest compressions are focused slightly higher on the sternum. However, exact hand placement is not specified and it is unknown if most responders are aware of this alteration [7–12]. In addition, in the absence of a return of spontaneous circulation (ROSC) within four minutes, immediate perimortem cesarean delivery (ameliorating caval compression) is indicated to achieve optimal maternal outcome [4,7,11,13–15].

Though the liver is often congested due to a lack of venous return during cardiac arrest, the rate of liver injury in the general population after CPR is low [16–18]. In pregnancy, hepatic congestion

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in addition to other physiologic changes are reported [7,19–22]. While an enlarged liver in pregnancy is only reported in patient with prior liver disease [19,20], a more palpable liver immediately postpartum has been reported [22].

We hypothesized that chest compressions performed on pregnant and "early postpartum" patients are associated with an increased rate of liver lacerations during CPR as compared to the general population. Our primary objective was to determine the rate of liver laceration as a complication of CPR in pregnancy.

Methods

Using a protocol approved by our institutional review board (HP-0071605), a retrospective case review was performed at the University of Maryland Medical Center (UMMC) from 2011 to 2016. Cases of CPR performed on peripartum women, including transfers from other hospitals, were identified both by inspection of obstetric, anesthesiology, and trauma databases and by query of UMMC discharge records, using codes: arrest (475.5) and pregnancy (v22.1). Patient demographics and details surrounding each cardiac arrest event including post-CPR complications were then gathered. Inclusion criteria were pregnancy (from 20 weeks' gestation to one year postpartum), suffering a cardiac arrest and CPR. Exclusion criteria included known prior liver injury or disease. Records were reviewed to determine liver injury after CPR.

The total number of peripartum women with cardiac arrest who receive CPR was divided by the total number of deliveries at UMMC from 2011 to 2016 to determine the period prevalence of CPR in pregnancy. The number of women with liver injury associated with CPR in pregnancy was divided by the previously determined total number of pregnancies complicated by cardiac arrest and CPR to determine the period prevalence of liver injury associated with CPR in pregnancy. A thorough literature review was performed to identify the rates of CPR as well as any published rates of liver injury from CPR both in the general population and in pregnant women.

Results

Including transfers to UMMC during 2011–2016, eleven cases of cardiac arrest and CPR in peripartum women were identified out of 9408 deliveries at UMMC. All eleven women met inclusion criteria (Table 1). Return of spontaneous circulation occurred in 7 of the patients (64%). Overall mortality was 82%. The period prevalence of cardiac arrest among all deliveries at UMMC during this six-year span was 0.12% (1:855). Liver lacerations occurred in three of the eleven women. The period prevalence of liver injury associated with CPR in pregnant women at UMMC was 27%, and was 43% amongst survivors of CPR. All three of these women suffered clinically significant liver lacerations, only one survived (Table 2).

Case 1

A 34-year-old G6P3, presented to Labor & Delivery at 31 weeks' gestation with abdominal pain and leakage of fluid. She had a history of diabetes mellitus (type 1), hypertension and chronic kidney disease. Her calculated BMI was 25 m^2/kg. She was diagnosed with preterm premature rupture of membranes. She was started on magnesium sulfate and steroids were administered. Shortly after administration of the magnesium, she became unresponsive and it was thought she had a seizure. Immediately following emergent delivery by cesarean section, the patient experienced cardiopulmonary arrest and ACLS was started. ROSC occurred fifteen minutes later. Massive abdominal haemorrhage continued after closure of the uterine incision; a hysterectomy was performed. She continued in shock despite massive transfusion and intravenous infusion of vasopressors. Further abdominal exploration revealed liver injury, including a: large (right lobe) subcapsular hematoma; laceration adjacent to the gallbladder; and, separate left infra-lobar laceration. Her postoperative course deteriorated further in the intensive care unit (ICU). Despite heroic measures, she remained unresponsive with evidence of brain death, expiring after termination of further resuscitative efforts.

Case 2

A 35-year-old G3P2 presented to an outside hospital (OSH) at 38 weeks' gestation with confusion, agitation, tachypnea and cyanosis. She offered no significant medical history. Her calculated BMI was 21 m^2/kg. Diagnosed with a pulmonary embolism, tPA (50 mg) was intravenously infused. Manifesting maternal shock and with a category III fetal heart rate pattern displayed on the electronic fetal heart rate monitor, she underwent abdominal delivery. In the immediate postpartum period, she was transferred to UMMC for veno-arterial ECMO. During cannulation of the right femoral artery, she lapsed into cardiac arrest. ACLS was initiated and ROSC was noted ten minutes later. A hysterectomy was performed for massive vaginal hemorrhage. Further abdominal exploration revealed liver injury including a ruptured subcapsular hematoma and a large infra-lobar (right) laceration. Echocardiography revealed a large left ventricular thrombus. Resuscitation, including hepatic artery embolization, was continued but unsuccessful and the patient expired the same day.

Case 3

A 24-year-old G3P2 presented to an OSH at 40 weeks' gestation in active labor. She had a history of uterine fibroids. Her calculated BMI was 28 m^2/kg. She underwent vacuum-assisted vaginal delivery. Subsequent massive (vaginal) haemorrhage, with clinical and laboratory signs of coagulopathy, led to hysterectomy. In the ICU, she suffered cardiac arrest. ACLS was performed; ROSC occurred. With continued clinical/laboratory signs of abdominal hemorrhage, the patient returned to the OR. Laparotomy revealed hepatic injury including a large linear infra-lobar (right) laceration and a large subcapsular hematoma of the dome. She remained haemodynamically unstable even after embolization of the distal right hepatic artery. She was transferred to UMMC. She was stabilized and her coagulopathy corrected. Damage-control exploration of her abdomen was performed followed ten days later by a delayed primary closure. The patient recovered and continues to do well.

Discussion

Added to the normally tumultuous scene occurring at any cardiac arrest, having a pregnant patient who requires CPR heightens anxiety for all healthcare providers involved. Furthermore, the scenario can become more complicated if they must prepare for a perimortem caesarean section (PMCS) if there is no return of spontaneous circulation within an ideal goal of four minutes [8–11,13–15].

The rate of CPR in the peripartum population of developed countries varies, including: The Netherlands (0.0019%) [4]; Scotland (0.002%) [5]; United Kingdom (0.0028–0.0063%) [3]; Canada (0.008%) [2]; and, the United States (0.085%) [1]. A study of maternal cardiac arrest in a Canadian tertiary care center reported a rate of 1:24,883 (0.004%), but excluded postpartum circulatory arrests [23].

The peripartum CPR rate seen at our institution is almost 15-fold (0.12% vs. 0.0085%) higher as compared to published rates [1]. A factor likely skewing our results is that as a tertiary care referral center, many of our obstetric patients are transferred from other

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