

Systematic review

Perimortem and postmortem caesarean section: a systematic review

María J.V. Contreras¹, Mariana G.P. González¹, Francisco A.A. Reyes¹, Fernando Y.R. Morales¹,
Hugo M. Zerón^{1,2}

¹ Faculty of Medicine, Autonomous University of the State of Mexico, Toluca, Mexico

² "Mónica Pretelini Sáenz" Maternal-Perinatal Hospital, Toluca, Mexico

Received 17 December 2021, Accepted 18 February 2022

© 2022, Contreras M.J.V., González M.G.P., Reyes F.A.A., Morales F.Y.R., Zerón H.M.

© 2022, Saratov Medical Journal

Abstract:

Rationale: Perimortem caesarean section (PMCS) is an emergency procedure performed in pregnant women over 20 weeks of gestation with cardiac arrest, in order to save the mother and the foetus, or only one of them.

The objective of the review was to present clinical traits and evaluate survival of mothers and newborns as well as the complications following PMCS.

Materials and methods: A systematic review between March and May 2021 was performed using the PRISMA method with the terms "perimortem caesarean section" "postmortem caesarean section", "maternal cardiac arrest", "perimortem caesarean section" AND "case report" "postmortem caesarean section" AND "case report".

Results: 23 papers from 12 countries with 39 cases were counted. Of the total sample, 17.94% of the mothers survived and of these, 42.85% had neurological complications. Of 39 newborns counted, 69.23% survived, 28.20% died and in 2.56% the information was missing. 30.76% of the cases followed the five-minute rule and 56.41% required 6 or more minutes, 12.82% did not specify time.

Conclusion: The results of this analysis demonstrated higher mortality in women who had a cardiac arrest during pregnancy related to the neonates who survived. The possibility of performing PMCS should neither be ruled out even if the established five-minute time frame has passed, nor should time be invested in verifying foetal viability.

Keywords: caesarean section, perimortem, postmortem.

Cite as Contreras MJV, González MGP, Reyes FAA, Morales FYR, Zerón HM. Perimortem and postmortem caesarean section: a systematic review. *Saratov Medical Journal* 2022; 3 (1): e0102.

Correspondence to Hugo M. Zerón. Autonomous University of the State of Mexico and "Mónica Pretelini Sáenz" Maternal-Perinatal Hospital, Paseo Tollocan Poniente 201, Universidad, 50010, Toluca, Mexico. E.mail: hmendietaz@gmail.com

Introduction

Pregnancy modifies multi-organ physiological and anatomical aspects in women, the presence of cardiac arrest is more likely to have catastrophic effects compared to non-pregnant women [1]. Among the main changes that have a direct impact and should be considered when performing quality cardiopulmonary resuscitation, especially after 20 weeks of gestation (WG), are circulatory, pulmonary, digestive, and respiratory changes [2, 3].

In the case of a possible cardiac arrest, probably the most important physiological modification is the inferior vena cava occlusion by the pregnant uterus when the pregnant woman is in the supine position, mainly after the 20th week of gestation; although there is evidence that after the 12th week there is some blood flow restriction of the inferior vena cava and the aorta at the infrarenal level [4, 5]. Factors that may affect the weight of the uterus include a macrosomic foetus, number of foetuses, polyhydramnios, the relationship of the foetus to the anatomic composition of the mother, and additional variables such as excess body mass and morbid obesity [6].

All the changes previously mentioned, explain the rapid onset of cardiorespiratory arrest in a hypoxic pregnant

woman and why a perimortem caesarean section (PMCS) has a specific role. A PMCS is defined as an emergency surgical procedure during cardiopulmonary resuscitation (CPR) in obstetrical patients at 20 WG or more. When this technique is performed, it helps improving the venous return [7], increasing the cardiac output by 25 to 56%, simulating a transfusion [2, 8].

The cardiac arrest incidence during pregnancy is infrequent, and varies according to the country in question, with 1 case per 12 500 pregnancies being recorded in USA between 1998 to 2011 [9] and 1 case per 30 000 in the United Kingdom [10]. However, a recent report on maternal cardiac arrest in the latter reported an increase in incidence over a 10-year span, whereas another survey reported a maternal mortality increment in the USA between 2000 and 2014 [11].

The causes of cardiac arrest directly related to pregnancy include hypertensive disorders (preeclampsia, eclampsia, HELLP syndrome [Hemolysis, Elevated Liver enzyme level, Low Platelet level]), obstetric or surgical hemorrhage, infection or sepsis, embolism (amniotic fluid embolism, air embolism, pulmonary embolism), anesthetic or drug-induced causes [12]. Other causes may include trauma, caused by accidents or injury from any type of weapon, in addition to

preexisting medical conditions such as arrhythmias, atherosclerosis, valvular disease, and vascular ischemia [13]. Whatever the cause, a rapid and right response is essential to optimize the maternal and foetal survival probability [9, 10].

The process of recognizing PMCS as an emergency measure to be performed within minutes of cardiac arrest has evolved over time. There is evidence that this surgery has been performed in cultures dating back to ancient times with the aim of delivering a living being through the deceased mother, hence it was first given the name "postmortem cesarean section" [14].

Moreover, in the thirteenth and fourteenth centuries there are evidence of legal mandates where all deceased pregnant women had to undergo a postmortem caesarean section in order to baptize and bury the babies that also died; a fatal outcome that was much more frequent than finding newborns under such circumstances [15]. The procedures performed in the 19th and 20th centuries focused on the possibility of foetal survival, particularly in cases where there was sudden cardiac maternal death in which the time between cardiac arrest and caesarean section was critical to this goal [16].

Given the low incidence or underestimated frequency of this phenomenon, it was not until 2010 that the AHA included the algorithm for basic and advanced resuscitation for pregnant patients [1, 17]. As a historical fact, on January 26th, 1776, the first postmortem caesarean section performed in Mexico, was during the Santa Clara California mission, carried out by Fray Joseph Viader and Fray Joseph Viñas; it was published in the National Gazette on May 29th of the same year [18].

The purpose of the review was to present clinical traits and evaluate survival of mothers and newborns as well as the complications following PMCS.

Materials and Methods

A systematic review was performed in PubMed, Google Scholar and Researchgate databases using the PRISMA method between March and May 2021 using the terms "perimortem caesarean section", "postmortem caesarean section", "maternal cardiac arrest", "perimortem caesarean section" AND "case report" "postmortem caesarean section" AND "case report" including their Spanish translation. The exclusion criteria were duplicate articles, review articles without clinical cases, cohort articles, systematic reviews, opinions and management guides in other living beings.

A table was prepared in which the results, complications and observations that arose during each case were reported, evaluating the following variables: year of the article, country, number of cases, characteristics of the pregnant woman, cause of the cardiac arrest, time of caesarean section since the cardiac arrest, survival of the mother and the newborn, as well as whether the latter required cardiopulmonary resuscitation and whether there were neurological complications in the binomial.

Results

Case reports were identified in which PMCS and postmortem caesarean section were of great importance for the cardiac arrest resolution. A total of 341 articles mentioning the keywords were found among the three databases chosen. After using the exclusion criteria 23 papers were included in the analysis (Figure 1), the oldest being

from 1948 and the most recent from 2020. Thirty-nine cases were counted where 13 were for PMCS and 26 were descriptions of postmortem caesarean section. Of the 28 articles found, 32.14% were written in the United States (n=9), 10.7% were in Colombia (n=3), as well as in the United Kingdom (n=3) and Turkey (n=3), 7.14% in Mexico (n=2) and China (n=2) and 3.5% in Scotland (n=1), Lebanon (n=1), New Zealand (n=1), Japan (n=1), Spain (n=1) and Norway (n=1).

The average age was 29.87 years with the youngest being 16 years and the oldest 43 years. Of the total number of women, 13 were primigravid, 24 were multigestational and 2 were unspecified. The average number of weeks of gestation was 32.1, with 26 preterm, 10 at term and 3 unspecified (preterm being considered all those born at 37 WG or less).

The most frequent causes of cardiac arrest obtained were heart disease associated or not with pregnancy, embolism, eclampsia, car accidents and gunshot wounds, which represent 51.28% of our population, with four cases for each cause, respectively. The remaining 43.58% included varied causes such as anesthetic complications (n=2), neurofibrosarcoma (n=1), aneurysms (n=2), cerebral hemorrhage (n=3), sarcomatosis (n=2), respiratory complications (n=2), preeclampsia (n=3), idiopathic thrombocytopenic purpura (n=1) and 1 case of massive hemorrhage due to puerperal complications. Of the total sample 5.12% were unspecified causes (n=2).

Regarding the time interval between cardiac arrest and PMCS, it was found that 12 cases (30.76%) followed the 5-minute rule and 22 (56.41%) required 6 or more minutes to perform the procedure. There were five cases that did not specify time, representing 12.82%. Of the total sample, only 7 (17.94%) of the mothers survived and of these, 3 of the survivors (42.85%) had neurological complications.

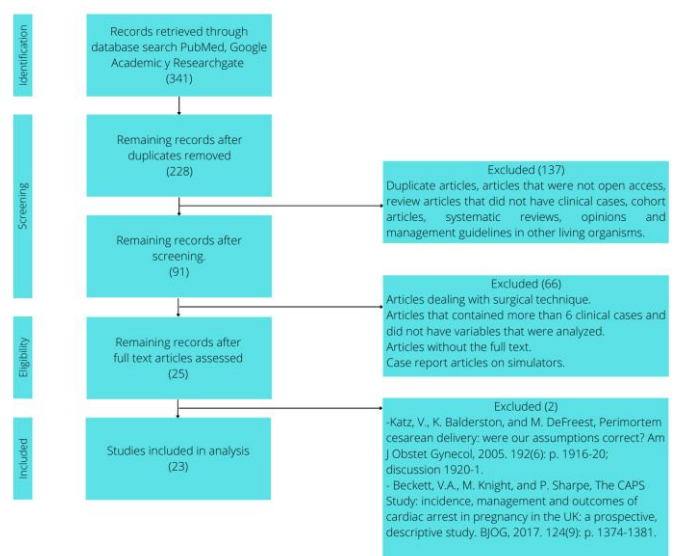


Figure 1. Research article identification and selection based on PRISMA method

The data on survival of 39 pregnant women and their foetuses are summarized in Table 1. Only 17.94% (7 cases) of the mothers survived. Of 39 newborns counted, 27 survived (69.23%), 11 died (28.20%) and 1 was unspecified (2.56%). Of

the 69.23% of survivors, 20 cases (74.07%) did not develop neurological complications while 7 neonates did (25.92%), including mental retardation (n=2), spastic quadriplegia (n=1), hydrocephalus (n=1), facial paralysis (n=1), cerebral palsy (n=1), and 1 unspecified case. In addition, of the 27 surviving neonates, 23 did not specify whether neonatal resuscitation maneuvers were used (58.97%), 15 did require those (38.46%) and 1 did not (2.56%).

Finally, of 11 stillbirths, at least 10 were born alive but died of unspecified causes (n=6), bronchopneumonia (n=1), respiratory distress syndrome (n=1), congenital intestinal obstruction (n=1), and multiple organ failure (n=1). The remaining case was an obituary.

Discussion

The decision to practice a PMCS should be based on two premises: the first is time, where theoretically the limit to avoid maternal-fetal neurological complications is 5 minutes [19], however, in practice it was reported that at least 22 cases had a time interval of more than 6 minutes, which can be explained by factors such as the transfer of the pregnant woman to the hospital, medico-legal implications, resistance to performing the procedure in a non-sterile area, waiting for the arrival of the specialist and resuscitation skills.

The second premise is that it should be done when the foetus is viable, that is between 20-24 WG. According to Zepeda et al. if the gestational age is less than 20 WG a PMCS is unlikely to improve the situation, if the gestational age is between 20-23 WG it may improve maternal survival, although fetal survival is very unlikely, and if the gestational age is greater than 24 WG the PMCS may improve maternal and neonatal survival [20, 21].

Table 1. Survival of mother and newborn in 39 cases of perimortem and postmortem caesarean section

| Country | Cases | Mother survival (%) | Newborn survival (%) |
|------------------------|-------|---------------------|----------------------|
| United States | 15 | No: 32 (82.05%) | No: 11 (28.21%) |
| [23,24,25,26,27] | 8 | Yes: 7 (17.95%) | Yes: 27 (69.23%) |
| Colombia [2,28,29] | 4 | | No reported: 1 |
| Turkey [30,31,32] | 2 | | (2.56%) |
| United Kingdom [33,34] | 2 | | |
| Mexico [18,35] | 1 | | |
| Scotland [36] | 1 | | |
| Lebanon [37] | 1 | | |
| New Zealand [38] | 1 | | |
| Japan [39] | 1 | | |
| Spain [40] | 1 | | |
| Norway [41] | 1 | | |
| China [42] | 1 | | |
| Taiwan/China [43] | | | |

In 1985 Katz et al. analyzed cases of postmortem caesarean section and found that 93% of live births were obtained with the procedure performed in the first 15 minutes and of these, 70% were born in the first 5 minutes [16]. Based on these observations, and the fact that the shorter the time interval between the presence of cardiac arrest and the caesarean section, there is less likelihood of developing fatal neurological consequences for both the mother and the foetus, leading to the coining of the term PMCS in 1986 [14, 16, 22].

It should be remembered that the primary reason for performing PMCS is maternal survival [2, 22] yet the results of this analysis demonstrated higher mortality in women who had a cardiac arrest during pregnancy related to the neonates who survived.

In terms of neonatal survival, the results fluctuate with the different types of studies found for this paper. Despite the results found by Katz et al. in 1985 in the case series analyzed, at least 27 of 39 neonates survived, 20 of whom had no neurological complications [16]. It should be noted that some of them were born after the regulatory 5 minutes to perform the PMCS. Therefore, the possibility of performing this procedure should not be ruled out even if the established time has passed, nor should time be invested in verifying foetal viability, as it is very likely that there is extreme bradycardia, which can be mistaken for absence of foetal heart rate [21, 22] and still have successful results.

On the other hand, the usefulness and potential benefit for maternal circulation of PMCS has been clear since 1982 when De Pece et al. reviewed the case of a 27-year-old woman with 36 WG who had a cardiac arrest, after removal of the foetus the mother recovered femoral and carotid pulses [23]. Also, in 1986, Katz et al. described 60% improvement in maternal cardiac output after PMCS, while in 2012 they reported a maternal survival of 61-80% [16]. On the other hand, a United Kingdom study was able to reach a maternal survival of 58% if adherence to resuscitation guidelines is met [10]. Contrastingly, of the total sample analyzed in this study, only 17.94% (7 cases) of the mothers survived.

In special cases, where due to maternal pathology the survival possibility is nullified, PMCS may be performed to save the life of the foetus, taking into consideration the gestational age. The ethical aspect of this decision is extremely important, especially in cases where a brain-dead pregnant mother is confirmed, although if foetal viability allows and conditions are adequate, PMCS should be considered even without the need for informed consent from the family [10].

During the course of this work there was a marked limitation in the reported information on PMCS. It was not found significant enough sample to describe a correlation between maternal comorbidities and their possible alteration with birth weight. Likewise, certain data on the surviving newborn are not known since they were not reported in the case studies, which is worrying given that they are significant data to generate a relevant and transcendent result in the field of obstetrics and paediatrics. Since 2009 the "Mónica Pretelini Sáenz" Perinatal Maternal Hospital (HMPMPS) located in Toluca, State of Mexico with 12 years of operation and 102,000 births, 3 PMCS were registered, which indicates a ratio of 1 case per 34 000.

The results found that despite a cardiac event is lethal in most of the mothers, PMCS is an option to try to save the life of the neonate. Due to the rarity of this phenomenon and the

ethical implications, there is no international guideline to be followed. However, this does not exempt physicians involved in the care of women, students, interns and residents from being prepared for such an emergency. Therefore, good simulator-based training is needed to get technical and non-technical competencies to improve the outcome of this situation.

Conclusion

The results of this analysis demonstrated higher mortality in women who had a cardiac arrest during pregnancy related to the neonates who survived. The possibility of performing PMCS should neither be ruled out even if the established five-minute time frame has passed, nor should time be invested in verifying foetal viability.

Acknowledgments

Authors thank the participation of the student team of the Latin American Scientific Association (ASCILA) for the ideas to improve the manuscript.

Conflict of interest

The authors declare no conflicts of interest pertaining to the study.

References

- 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 (18 Suppl 3):S829-61. *Erratum in: Circulation* 2011; 124(15): e405 <https://doi.org/10.1161/CIRCULATIONAHA.110.971069>
- Urrego JLA, Cárdenas CDP, Velázquez VJF, et al. Perimortem c-section and fetal maternal resuscitation in the emergency department: case report and review of the literature. *Rev Asoc Mex Crit y Ter Int* 2012; 26:247-250.
- Tan EK, Tan EL. Alterations in physiology and anatomy during pregnancy. *Best Pract Res Clin Obstet Gynaecol*. 2013; 27(6):791-802. <https://doi.org/10.1016/j.bpobgyn.2013.08.001>
- De-Giorgio F, Grassi VM, Vetrugno G, et al. Supine hypotensive syndrome as the probable cause of both maternal and fetal death. *J Forensic Sci*. 2012; 57(6): 1646-1649. <https://doi.org/10.1111/j.1556-4029.2012.02165.x>
- Eldridge AJ, Ford R. Perimortem caesarean deliveries. *Int J Obstet Anesth*. 2016; 27: 46-54. <https://doi.org/10.1016/j.ijoa.2016.02.008>
- Jeejeebhoy FM, Zelop CM, Lipman S, et al. Cardiac Arrest in Pregnancy: A Scientific Statement From the American Heart Association. *Circulation*. 2015; 132(18): 1747-73. <https://doi.org/10.1161/CIR.0000000000000300>
- Gatti F, Spagnoli M, Zerbi SM, et al. Out-of-Hospital Perimortem Cesarean Section as Resuscitative Hysterotomy in Maternal Posttraumatic Cardiac Arrest. *Case Rep Emerg Med*. 2014; 2014: 121562. <https://doi.org/10.1155/2014/121562>.
- Katz V, Balderston K, DeFrest M. Perimortem cesarean delivery: were our assumptions correct? *Am J Obstet Gynecol*. 2005; 192(6): 1916-1920. (DOI: <https://doi.org/10.1016/j.ajog.2005.02.038>)
- Mhyre JM, Tsen LC, Einav S, et al. Cardiac arrest during hospitalization for delivery in the United States, 1998-2011. *Anesthesiology*. 2014; 120(4): 810-818. <https://doi.org/10.1097/ALN.000000000000159/>
- Beckett VA, Knight M, Sharpe P. The CAPS Study: incidence, management and outcomes of cardiac arrest in pregnancy in the UK: a prospective, descriptive study. *BJOG*. 2017; 124(9): 1374-1381. <https://doi.org/10.1111/1471-0528.14521>
- Schaap TP, Overtoom E, van den Akker T, et al. Maternal cardiac arrest in the Netherlands: A nationwide surveillance study. *Eur J Obstet Gynecol Reprod Biol*. 2019; 237: 145-150. <https://doi.org/10.1016/j.ejogrb.2019.04.028>
- Dijkman A, Huisman CM, Smit M, et al. Cardiac arrest in pregnancy: increasing use of perimortem caesarean section due to emergency skills training? *BJOG* 2010; 117(3): 282-287. <https://doi.org/10.1111/j.1471-0528.2009.02461.x>
- Zelop CM, Einav S, Mhyre JM, Martin S. Cardiac arrest during pregnancy: ongoing clinical conundrum. *Am J Obstet Gynecol*. 2018; 219(1): 52-61. <https://doi.org/10.1016/j.ajog.2017.12.232>
- Fadel HE. Postmortem and perimortem cesarean section: historical, religious and ethical considerations. *JMA*. 2011; 43(3): 194-200. <https://doi.org/10.5915/43-3-7099>
- Katz VL. Perimortem cesarean delivery: its role in maternal mortality. *Semin Perinatol*. 2012;36(1):68-72. (doi:0.1053/j.semperi.2011.09.013) (PMID: 22280869)
- Katz VL, Dotters DJ, Droegemueller W. Perimortem cesarean delivery. *Obstet Gynecol*. 1986; 68(4): 571-576.
- Einav S, Kaufman N, Sela HY. Maternal cardiac arrest and perimortem cesarean delivery: evidence or expert-based? *Resuscitation*. 2012; 83(10): 1191-2000. <https://doi.org/10.1016/j.resuscitation.2012.05.005>
- Juárez AA CM, Romero HS, Motta ME. Operación cesárea postmortem con supervivencia fetal. Informe de un caso. *Rev.Med.Hosp.Gen.Mex*.1999; 62: 132 -134.
- Vasco-Ramírez M. Resucitación cardiopulmonar en la embarazada. *Rev. Colomb. de Anestesiología*. 2004; 32(4): 243-251. <https://doi.org/10.18597/rcog.50>
- Zepeda-Mendoza A. Reanimación Cardiopulmonar en la paciente embarazada Ciudad de México: Academia Nacional de Medicina, México; 2018 [Available from: <https://www.asieslamedicina.org.mx/reanimacion-cardiopulmonar-en-la-paciente-embarazada/>].
- Kikuchi J, Deering S. Cardiac arrest in pregnancy. *Semin Perinatol*. 2018; 42(1): 33-38. <https://doi.org/10.1053/j.semperi.2017.11.007>
- Whitten M, Irvine LM. Postmortem and perimortem caesarean section: what are the indications? *J R Soc Med*. 2000; 93(1): 6-9. <https://doi.org/10.1177/014107680009300103>
- DePace NL, Betesh JS, Kotler MN. 'Postmortem' cesarean section with recovery of both mother and offspring. *JAMA*. 1982; 248(8): 971-973. <http://www.ncbi.nlm.nih.gov/pubmed/7097967>
- Weber CE. Postmortem cesarean section: review of the literature and case reports. *Am J Obstet Gynecol*. 1971; 110(2): 158-165. [https://doi.org/10.1016/0002-9378\(71\)90600-4](https://doi.org/10.1016/0002-9378(71)90600-4)
- Arthur RK. Postmortem cesarean section. *Am J Obstet Gynecol*. 1978; 132(2): 175-179. [https://doi.org/10.1016/0002-9378\(78\)90921-3](https://doi.org/10.1016/0002-9378(78)90921-3)
- Aronsohn J, Danzer B, Overdyk F, Roseman A. Perimortem cesarean delivery in a pregnant patient with goiter, preeclampsia, and morbid obesity. *A A Case Rep*. 2015; 4(4): 41-43. <https://doi.org/10.1213/XAA.0000000000000116>
- Adan AJ, Nafday A, Beyer AB, et al. Use of Tandem Perimortem Cesarean Section and Open-Chest Cardiac Massage in the Resuscitation of Peripartum Cardiomyopathy Cardiac Arrest. *Ann Emerg Med*. 2019; 74(6): 772-774. <https://doi.org/10.1016/j.annemergmed.2019.03.012>
- Sanchez Torres F. Postmortem cesarean section. *Rev Colomb Obstet Gynecol*. 1963; 14: 327-331.
- Cuesta-Galindo MG, Ruvalcaba-Carrillo R, Colín-Cortés HM, et al. Código azul, histerotomía de reanimación en embarazo de término: reporte de un caso. *Ginecol Obstet Mex*. 2020; 88(10): 700-706. <https://doi.org/10.24245/gom.v88i10.3451>

30. Yildirim C, Goksu S, Kocoglu H, et al. Perimortem cesarean delivery following severe maternal penetrating injury. *Yonsei Med J.* 2004; 45(3): 561-563. <https://doi.org/10.3349/ymj.2004.45.3.561>
31. Guven S, Yazar A, Yakut K, et al. Postmortem cesarean: report of our successful neonatal outcomes after severe trauma during pregnancy and review of the literature. *J Matern Fetal Neonatal Med.* 2012; 25: 1102-1104. <https://doi.org/10.3109/14767058.2011.622419>
32. Mete-Ural Ü. Postmortem Cesarean Section: A Case Report. *J Clin Anal Med.* 2013; 4(4): 321-323. <https://doi.org/10.4328/JCAM.650>
33. Smith GE. Postmortem caesarean section. A case report. <https://doi.org/10.1111/j.1471-0528.1973.tb02177.x>
34. Woods M. Prehospital Perimortem Caesarean Section – A Survivor. *Prehosp. Emerg. Care* 2020; 24(4): 595-599. <https://doi.org/10.1080/10903127.2019.1671563>
35. Meza-Félix E, Betancourt-Vázquez M, Moncada-Moreno E, et al. Cesárea perimortem por trauma penetrante por proyectil de arma de fuego con supervivencia fetal. Reporte de un caso. *Rev. Fac. Med.* 2018; 61: 24-28.
36. Watt AH. Successful postmortem caesarean section following maternal intracranial haemorrhage. *Scott Med J.* 1985; 30(4): 234. <https://doi.org/10.1177/003693308503000409>
37. Awwad JT, Azar GB, Aouad AT, et al. Postmortem cesarean section following maternal blast injury: case report. *J Trauma.* 1994; 36(2): 260-261. <https://doi.org/10.1097/00005373-199402000-00023>
38. Kazandi M, Mgoji L, Gundem G, et al. Post-mortem Caesarean section performed 30 minutes after maternal cardiopulmonary arrest. *Aust N Z J Obstet Gynaecol.* 2004; 44(4): 351-353. <https://doi.org/10.1111/j.1479-828X.2004.00215.x>
39. Matsubara S, Usui R, Watanabe T, et al. Perimortem cesarean section or perimortem cesarean supracervical hysterectomy? *Arch Gynecol Obstet.* 2013; 287(2): 389-390. <https://doi.org/10.1007/s00404-012-2513-1>
40. González-Mesa E, Narbona I, Blasco M, Cohen I. Unfavorable course in pregnancy-associated thrombotic thrombocytopenic purpura necessitating a perimortem Cesarean section: a case report. *J Med Case Rep.* 2013;7:119. <https://doi.org/10.1186/1752-1947-7-119>
41. Lenz H, Stenseth LB, Meidell N, Heimdal HJ. Out-of-Hospital Perimortem Cesarean Delivery Performed in a Woman at 32 Weeks of Gestation: A Case Report. *A A Case Rep.* 2017; 8(4): 72-74. <https://doi.org/10.1213/XAA.0000000000000429>
42. Lee CY, Kung SW. Perimortem caesarean section: A case report of an out-of-hospital arrest pregnant woman. *World J Emerg Med.* 2018;9(1):70-72. <https://doi.org/10.5847/wjem.j.1920-8642.2018.01.012>
43. Wu SH, Li RS, Hwu YM. Live birth after perimortem cesarean delivery in a 36-year-old out-of-hospital cardiac arrest nulliparous woman. *Taiwan J Obstet Gynecol.* 2019; 58(1): 43-45. <https://doi.org/10.1016/j.tjog.2018.11.007>

Hugo Mendieta Zerón – MD, PhD, FACP. Faculty of Medicine, Autonomous University of the State of Mexico and Maternal-Perinatal Hospital “Mónica Pretelini Sáenz”, Toluca, Mexico. <https://orcid.org/0000-0003-3492-8950>.

Authors:

María José Vargas Contreras – MD. Faculty of Medicine, Autonomous University of the State of Mexico, Toluca, Mexico. <https://orcid.org/0000-0001-5390-5362>

Mariana Guadalupe Pineda González – MD. Faculty of Medicine, Autonomous University of the State of Mexico, Toluca, Mexico. <https://orcid.org/0000-0003-1013-9500>

Francisco Andrés Alcántara Reyes – MD. Faculty of Medicine, Autonomous University of the State of Mexico, Toluca, Mexico. <https://orcid.org/0000-0003-0856-5703>

Fernando Yael Rodríguez Morales – Faculty of Medicine, Autonomous University of the State of Mexico, Toluca, México. <https://orcid.org/0000-0003-1240-0928>