การศึกษาความชุกของการผ่าตัดคลอดขณะที่หัวใจหยุดเต้นในหญิงตั้งครรภ์หัวใจหยุดเต้นและผลลัพธ์การรักษาด้วยวิธีการทบทวนอย่างเป็นระบบและการวิเคราะห์อภิมาน

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บทคัดย่อ

บทนำ

ปัจจุบัน the American Heart Association/ American Stroke Association (AHA/ASA) ได้รวมการผ่าตัดคลอดขณะที่หัวใจหยุดเต้น เข้าเป็นส่วนหนึ่งในการนวดหัวใจผายปอดกู้ชีพหญิงตั้งครรภ์ แต่ผลลัพธ์หลังจากการผ่าตัดคลอดขณะที่หัวใจหยุดเต้นยังไม่ชัดเจน

วัตถุประสงค์

วัตถุประสงค์หลัก คือ การทบทวนอย่างเป็นระบบและการวิเคราะห์อภิมานเพื่อวัดความชุกและอัตราการรอดชีวิตของมารดาและทารก และผลสืบเนื่องภายหลังการผ่าตัดคลอดขณะที่หัวใจหยุดเต้นในหญิงตั้งครรภ์หัวใจหยุดเต้น และวัตถุประสงค์รอง คือ เพื่อศึกษาปัจจัยที่สัมพันธ์กับผลลัพธ์ภายหลังการผ่าตัดคลอดขณะที่หัวใจหยุดเต้นในหญิงตั้งครรภ์หัวใจหยุดเต้น

ระเบียบวิธีวิจัย

ฐานข้อมูล Medline และ Scopus นับตั้งแต่เริ่มมีฐานข้อมูลจนถึงเดือนกันยายน พ.ศ.2562 ได้รับการสืบค้น การศึกษาที่เกี่ยวข้องถูกเลือกโดยผู้เลือก 2 คนที่ไม่เกี่ยวข้องกัน ความชุกของการผ่าตัดคลอด

ขณะที่หัวใจหยุดเต้นและอัตราการรอดชีวิตของมารดาและทารกได้รับการวิเคราะห์อภิมานด้วย random effect model

ผลการศึกษา

จาก 645 การศึกษา มี 6 การศึกษาได้ถูกรวมเข้าสู่การวิเคราะห์ 4 การศึกษาอยู่ในยุโรปและ 2 การศึกษาอยู่ในเอเชีย ความชุกอภิมานของการผ่าตัดคลอดขณะที่หัวใจหยุดเต้นในหญิงตั้งครรภ์หัวใจหยุดเต้นเท่ากับร้อยละ 53 (95% CI: 23%, 80%) อัตราการรอดชีวิตของมารดาและทารกอภิมานเท่ากับร้อยละ 37 (95% CI: 18%, 56%) และร้อยละ 54 (95% CI: 24%, 84%) ตามลำดับ มี 1 การศึกษาชี้ว่า อัตราการรอดชีวิตของหญิงตั้งครรภ์ที่หัวใจหยุดเต้นจะสูงกว่าหากได้รับการผ่าตัดคลอดขณะที่หัวใจหยุดเต้นแต่ไม่มีนัยสำคัญทางสถิติ

สรุป

ครึ่งหนึ่งของหญิงตั้งครรภ์ที่หัวใจหยุดเต้นได้รับการผ่าตัดคลอดขณะที่หัวใจหยุดเต้น ในจำนวนนี้พบมารดารอดชีวิตร้อยละ 37 และทารกรอดชีวิตร้อยละ 54 อย่างไรก็ตามไม่พบความแตกต่างอย่างมีนัยสำคัญทางสถิติของผลลัพธ์ระหว่างการได้รับและไม่ได้รับการผ่าตัดคลอดขณะที่หัวใจหยุดเต้น

คำสำคัญ

ภาวะหัวใจหยุดเต้นในหญิงตั้งครรภ์ การผ่าตัดคลอดขณะที่หัวใจหยุดเต้นในหญิงตั้งครรภ์ หญิงตั้งครรภ์

Prevalence and outcomes of perimortem cesarean delivery among pregnant cardiac arrests: A systematic review and meta-analysis

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Abstract

Introduction

Currently, the American Heart Association/ American Stroke Association (AHA/ASA) included perimortem cesarean delivery (PMCD) as a part cardiopulmonary resuscitation (CPR) in pregnancy. But the number of maternal and fetal survival after PMCD remained unclear.

Objectives

The objectives were to conduct a systematic review and meta-analysis for determining prevalence of PMCD, maternal and fetal survival rates, and sequelae after PMCD among cardiac arrest in pregnant women. The secondary objective was to study the factors associated with outcomes after PMCD.

Methods

Medline and Scopus databases were searched to locate relevant studies from conception to september 2019. Studies were selected and extracted data by two independent reviewers. Prevalence of PMCD and survival rate of mother and fetus were pooled using random effect model.

Results

Of total 645 studies, 6 studies were included in final analysis. Four studies were in Europe and 2 studies were in Asia. The pooled prevalence of PMCD among cardiac arrest in pregnancy was 53% (95% CI: 21%, 84%). The pooled maternal and fetal survival rate after PMCD were 37% (95% CI: 18%, 56%) and 54% (95% CI: 24%, 84%), respectively. One study indicated higher maternal survival rate after receiving PMCD but there was no significant.

Conclusion

Half of CA in pregnant women received PMCD. Of those, 37% of pregnant women and 54% of their infants survived after resuscitation. However, there was no different maternal survival between receiving and do not receiving PMCD.

Keywords

perimortem cesarean delivery, pregnancy, cardiac arrest

Introduction

Cardiac arrest (CA) is the most important emergency situation but it is very rare in pregnancy. This incidence was approximately 1 in 30,000 pregnancies for in hospital cardiac arrest (IHCA) and 1 in 100,000 pregnancies for out of hospital cardiac arrest (OHCA)[1-3]. Aortocaval compression is special considerations for the resuscitation pregnant CA[4,5]. Perimortem cesarean delivery (PMCD) is the most invasive procedure to relieve aortocaval compression, compared to left uterine displacement and left lateral tilt. PMCD is the cesarean section performed in pregnancy who developed CA to optimize the condition of both mother and fetus. In 2020, The American Heart Association/ American Stroke Association (AHA/ASA) currently included PMCD as a part of special consideration in cardiopulmonary resuscitation (CPR) in pregnancy[6]. Although, this procedure was recommended to start within 5 minutes after collapse or as soon as possible[7], the number of evidences is limited and the outcomes after performing remain unclear. The primary aim of this study was to conduct a systematic review and meta-analysis for determining prevalence of PMCD, maternal and fetal survival rates, and sequelae after PMCD among CA in pregnant women and infants. The secondary aim was to study the factors associated with outcome after PMCD.

Methods

Search strategy and criteria

Medline and Scopus were used for a systematic searching since conception to July 2019. Search term included [("Pregnant" or "pregnancy") AND ("Cardiac arrest" or "Asystole") AND ("Cesarean section" or "Caesarean section")] OR ("resuscitative hysterotomy" or "perimortem cesarean section" or "perimortem cesarean delivery" or "perimortem caesarean section" or "perimortem caesarean delivery").

The human studies to be included in the review were one of these followings:

1) Contained prevalence of PMCD performed in pregnant woman who were in CA

2) Had maternal or neonatal survival rate

3) Had the factors associated with PMCD outcomes or their sequelae.

Studies were excluded if the population was not a pregnant woman with CA and

did not perform PMCD, insufficient data, not published in English, narrative reviews, case reports, case series, book section or conference paper.

Study selection and data extraction were done by 2 independent reviewers (CW, SW). The Newcastle-Ottawa scale for accessing quality of cohort and cross-sectional studies was used for assessing risk of bias assessment[8].

Statistical analysis

The pooled prevalence of PMCD among CA in pregnancy, maternal and fetal survival rate with their 95% confidence interval (CI) were estimated, using 'metaprop' command[9]. Heterogeneity was declared if P value of Cochran's Q test < 0.1 or $I^2 \geq 25\%$ (10). Then, random effect model was used when heterogeneity was detected[10]. Odds Ratio (OR) of 1) maternal survival in PMCD vs non-PMCD group and 2) factors associated to maternal and fetal survival among CA who received PMCD were calculated. Stata program version 15.0 were used for statistical analysis.

Results

Of total 645 studies, 224 studies and 415 studies were excluded due to duplication and exclusion criteria, respectively. Therefore, 6 studies were included in final analysis. **(Figure 1)**

Characteristics of included studies were showed in **Table 1**.

Prevalence of PMCD and maternal/ fetal survival after PMCD

The pooled prevalence of PMCS among CA in pregnancy among 5 studies (2, 11-14) was 53% (95%CI: 21%, 84%), see **Figure 2(A)**. Sensitivity analysis by excluding one study in Asia[12] indicated there was no difference result with pooled prevalence = 53% (95% CI: 17%, 90%). The maternal survival rate after PMCD ranged from 17% to 55%[2,11,12,14,15] with pooled prevalence 37% (95% CI: 0.18, 0.56). Subgroup analysis indicated that pooled prevalence in Asia[12,15] was higher than Europe[2,11,14] (50% versus 31%), see **Figure 2(B)**. The fetal survival rate after PMCD ranged from 18% to 89%[2,11,12,14,15] with pooled prevalence 54% (95% CI: 24%, 84%). The pooled prevalence of studies in Asia[12,15] was higher than those in Europe[2,11,14] (64% versus 50%), see **Figure 2(C)**.

PMCD VS non-PMCD

Only 1 study[11] was eligible to assess the effect of receiving PMCD versus did not receiving PMCD on maternal survival. The risk ratio of survival among pregnant

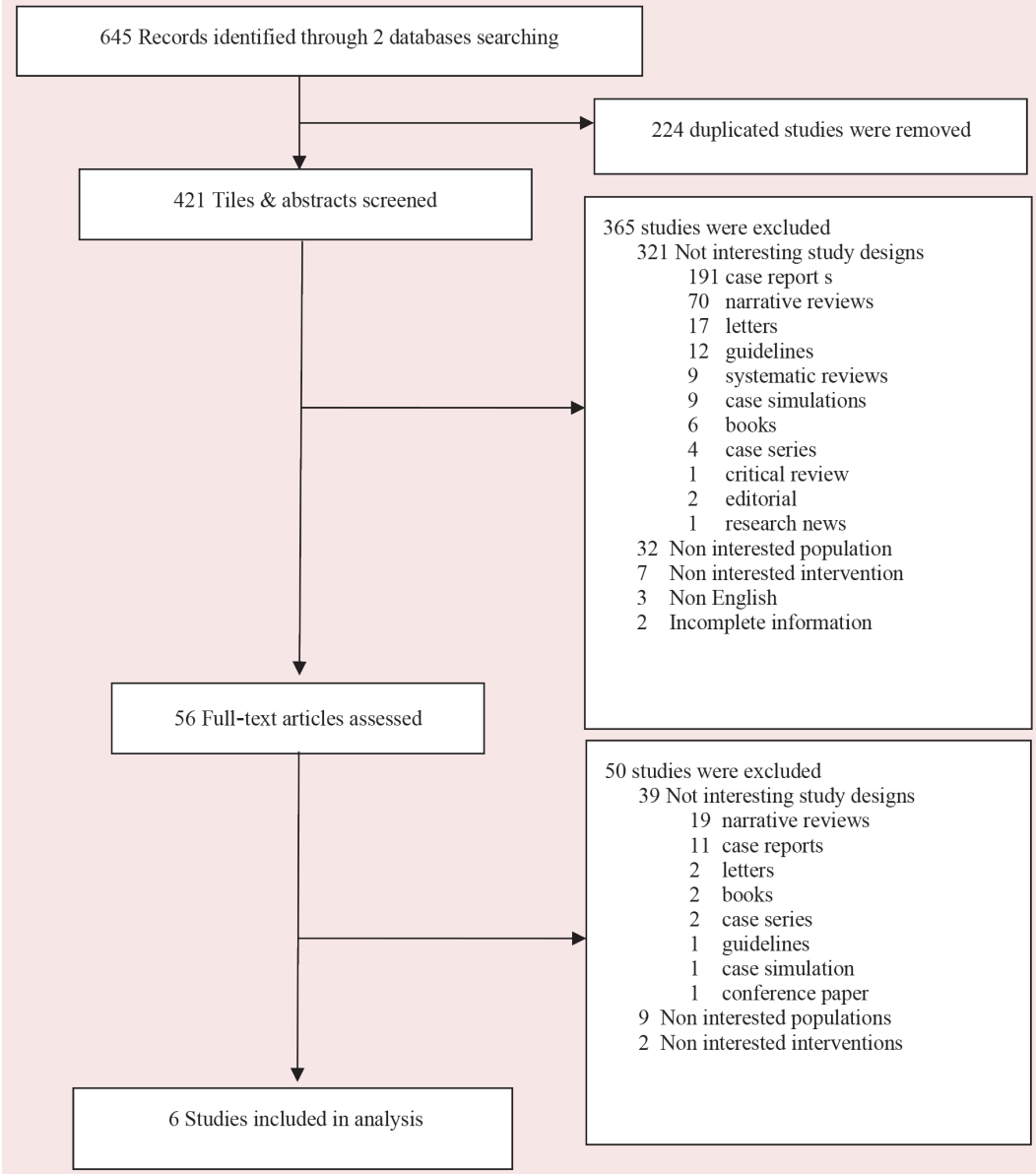

Figure.1 Study selection

Table 1. Characteristic of included studies

Authors	Years	Country	Regions	Study design	Study period	Target population	Target GA (weeks)	Median GA (weeks)	Median age (years)	Place of resuscitation	Sample size	Under-went PMCD	Survival after PMCD	
													Maternal	Fetal
Dijkman[11]	2009	Netherlands	Europe	Cohort	1993-2008	Pregnancy	All cases	34	33	In and out-of-hospital	55	12	2	5
Beckett[2]	2016	UK	Europe	Cross-sectional	2011-2014	Pregnancy	>20	37	N/A	ED and out-of-hospital	66	49	26	31
Shusaku[15]	2019	Japan	Asia	Cross-sectional	2010-2015	PMCD in pregnancy	>20	37	N/A	ED and OR	N/A	18	9	12
Timme[14]	2019	Netherlands	Europe	Cross-sectional	2013-2016	Pregnancy	>20	31	N/A	In and out-of-hospital	14	11	2	2
Maurin[13]	2018	France	Europe	Cross-sectional	2009-2014	OHCA	>20	32	N/A	In and out-of-hospital	10	3	0	0
Huang[12]	2012	China	Asia	Cross-sectional	2005-2009	Pregnancy	All cases	N/A	N/A	In hospital	8	4	2	2

ED indicates emergency department, GA: gestational age, N/A: not applicable, OR: operating room, and UK: United Kingdom.

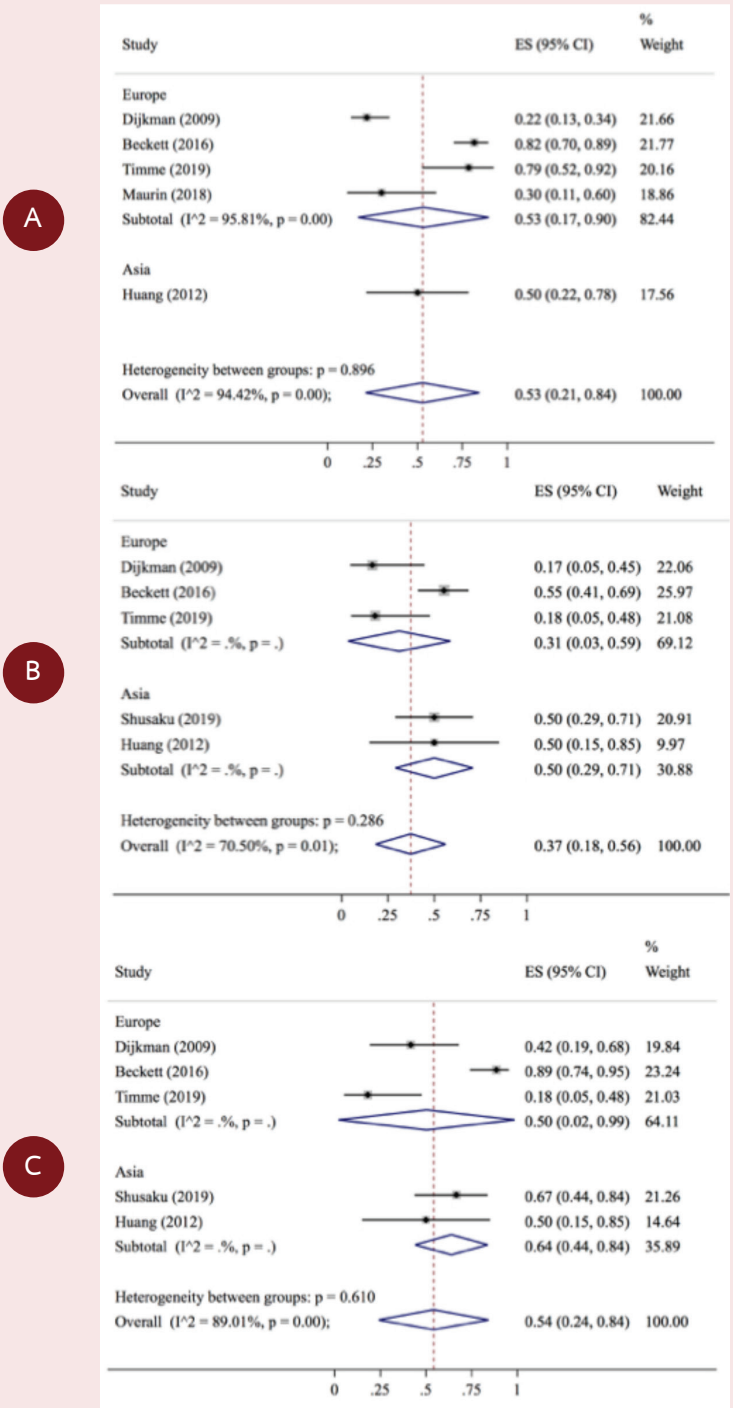

Figure 2. Meta-analysis of prevalences of PMCD (A), survival rate of mother (B) and fetus (C)

woman who received PMCD versus did not receiving PMCD was 1.23 (95% CI: 0.11, 8.39). Whereas, Maurin et al[13] reported that there was no survivor in both PMCD and non-PMCD groups among out of hospital CA pregnancy.

Sequelae of maternal and fetal survivors after PMCD

There were 2 studies[11,15] reported sequelae of survivors after receiving PMCD. Only 33% of maternal survivors were healthy, whereas at least 25-75% of fetal survivors had no complication, see **Table 2**.

Factors associated with maternal and fetal survival after PMCD

There were 3 studies[2,11,15] provided information of factors associated with survival after PMCD. Time from collapse to PMCD, place of cardiac arrest (IHCA versus OHCA) and PMCD performed at location of CA were identified to be possible independent factors of maternal survival. However, the significance was still controversy, see **Table 3**.

Table 2. Sequelae of maternal and fetal survivors after PMCD

Patients	Authors	Years	Number		Sequelae
			PMCD	Survivors	
Mother	Dijkman[11]	2009	12	2	50% neurological damage at radial region of right hand 50% vascular dementia with sign of delirium
	Shusaku[15]	2019	18	9	33% Healthy 56% Hypoxic encephalopathy 11% Lower-limb disuse syndrome
Fetus	Dijkman[11]	2009	12	5	75% Healthy 25% Hypoxic encephalopathy
	Shusaku[15]	2019	18	12	25% Healthy 75% Hypoxic encephalopathy

Table 3. Factor associated with maternal and fetal survival among CA in pregnancy who received PMCD

Patients	Variables	No. of studies n (%)	Authors	years	Exposure		Non-exposure		Adjusted OR (95% CI)
					Factors	survival rate	Factors	survival rate	
Mother	Time from collapse to PMCD (mean)	2 (33%)	Beckett (2)	2016	3 minutes in survivors#		12 minutes in non-survivors#		N/A
			Shusaku (15)	2019	6 minutes in survivors without complication		32 minutes in non-survivors		N/A
	Place of CA	1 (17%)	Dijkman (11)	2019	IHCA	2/8	OHCA	0/4	3.46 (0.13, 90.68)
	PMCD performed at location of collapse	1 (17%)	Beckett (2)	2016	Yes	18/25	No	8/22	4.50 (1.13, 18.54)
Fetus	Time from collapse to PMCD	2 (33%)	Beckett (2)	2016	≤ 5minutes	24/25	> 5 minutes	7/10	N/A
			Shusaku (15)	2019	3 minutes in survivors without complication		22 minutes in non-survivors		N/A
	Place of CA	1 (17%)	Dijkman (11)	2019	IHCA	5/8	OHCA	0/4	14.14 (0.57, 352.03)

CA indicates cardiac arrest, CI: confidence interval, ED: emergency department, GA: gestational age, IHCA: in hospital cardiac arrest, N/A: not applicable, OHCA: out of hospital cardiac arrest, OR: operating room, PMCD: perimortem cesarean delivery, and UK: United Kingdom.

#Median

Discussion

From this study shown that approximately half of CA in pregnant women received PMCD

PMCD is recommended by American Heart Association 2020 Guidelines as special consideration for resuscitation among CA in pregnancy7. Previously, the incidence of CA during pregnancy is 1/30,000 in 1986, and only 188 cases were reported[7]. According to our study, the meta-analysis was conducted to assess the prevalence of PMCD from 1993-2016. We found that 53% of CA in pregnancy were received PMCD. The result might indicate that PMCD obtained more attention as it had been previously reported. However, included studies were mainly conducted in Europe[2,11,13,14]. Therefore, this might not represent the PMCD across the world, which health system and emergency medical service might be different.

There was high probability of survival among pregnancy and fetus but their sequelae should be considered.

Generally, only 23.7%-37.5% CA patients recovered after resuscitation[16]. Our study found 37% of pregnancy and 54% of fetus survived after PMCD. This might be due to several reasons; PMCD is recommend to undergo within 5 minutes after cardiac arrest[7]. Therefore, patients who received PMCD were found very early after CA. In addition, this operation required prompt situation. They might be resuscitated in prompt location, with readiness of equipment and staff member, e.g. labor or operation room. These might increase chance of survival.

Our subgroup analysis suggested that there were higher maternal and fetal survival rate of studies in Asia than Europe. These might be due to studies in Asia[12,15] included only IHCA patients who might have better prognosis because of rapid receiving resuscitation after collapse whereas studies in Europe[2,11,13,14] included both in and out-of-hospital cardiac arrest.

According to limited evidence, there was no significant difference of maternal survival rate between receiving and did not receiving PMCD. Our result yielded more than 33% of them had permanent neurological deficit. Although, there was high survival rate, compared to other causes of cardiac arrest, quality of life of mother and infant who survived after PMCD should be well concerned. In Practice, decision to

perform PMCD still has to be discussed.

Factors associated with survival among CA pregnancy who receiving PMCD Based on recommendation, PMCD should be started within 4-5 minutes after CA and perform at the location of cardiac arrest[7]. Our result has only few studies[2,11,15] provided data about factors associated to maternal and fetal survival after receiving PMCD. Based on limited evidences, shorter time from CA to PMCD and IHCA increase chance of survival. This might be due to patients were found rapidly after collapse in suitable environment for resuscitation which consequently lead to had better prognosis.

Limitations

There were small number of studies included in this review. Consequently, this might bias the result. However, we exhaustively searched across 2 databases and complied to recommendation to conduct systematic review.

Conclusion

There was 53% of CA in pregnant women received PMCD. Of those, 37% of pregnant women and 54% of their infants survived after resuscitation. However, there was no different maternal survival between receiving and do not receiving PMCD. Time from collapse to PMCD, place of CA and PMCD performed at location of CA were possibly factors associated to maternal and fetal survival.

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