Experiences with High Success Rate of External Cephalic Version and Comparisons of Different Tocolysis for Risk-effective version based on a bayesian network meta-analysis

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Research article

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Abstract

Background: External cephalic version (ECV) has been proved effectively in reducing the cesarean section rates, but the success rates of the procedure are uneven. Experiences of ECV with high success rate were concluded in this paper. And in order to evaluate the efficiency of the applied tocolytic agents, a corresponding bayesian-network meta-analysis was conducted.

Methods: Through retrospective analysis of eighty-four single pregnant women with breech presentation near or at term who received ECV from Dalian Maternal and Child Health Care Hospital from April 2017 to November 2019, influence factors associated with the success rate of ECV were analyzed. Meanwhile, a bayesian-network meta-analysis including sixteen eligible randomized controlled trials (RCTs) about comparisons of five common tololytic agents and placebo with 3468 participants searched from Pubmed, Cochrane library and Embase databases until May 20, 2019 was conducted to identify the efficiency of ritodrine and terbutaline applied in the authors' procedures.

Results: The ECV procedures were conducted by a skilled obstetrician through strict selection of the candidates. Oral ritodrine, intravenous terbutaline in combination with epidual analgesia were applied as interventions. Success rate of ECV reached 90.48% (76/84) and the overall vaginal delivery rate is up to 88.16% (67/76). Only one patient reverted to breech presentation due to loose of the bellyband. Among the possible variables, amniotic fluid index were identified to have significantly relationship with the success rate of ECV. As the bayesian network meta-analysis proved: terbutaline, salbutamol and ritodrine played more important roles than nitroglycerine and nifedipine on the success rate of ECV. But salbutamol was found to have more common side effects than terbutaline and ritodrine.

Conclusions: We conclude that factors influencing the success rate of ECV mainly include: 1. characteristics of the mothers and fetuses, 2. interventions, 3. skills of the surgeon. During ECV process, selection of patients with enough amniotic fluid and proper stature with no contraindications is essential. And a more detailed scoring standard according to the possible influence indicators of the mothers and fetuses for the feasibility of ECV should be set up in the future. Besides, application of terbutaline and ritodrine as tocolytic agents during ECV procedure were considered to be effective for increasing successful versions.

Introduction

Breech presentation occurs in 3–4% of term pregnancies[1]. It has become a common sense that planned cesarean section(CS) is better than planned vaginal birth for the term breech presentation fetus, since the publication of a RCT on 2000, which could significantly reduce the perinatal and neonatal mortality[2]. Breech presentation had become the third most frequent indication for CS, and the CS rate of breech presentation patients keeps increasing, up to 93% in certain countries[3–5]. However, the global average CS rate increased 12.4% (from 6.7–19.1%) with an average annual growth rate of 4.4% between 1990 and 2014, on account of trend analysis with the data from 121 countries, especially in China[6]. Chinese

health facilities had the highest CS rate of 46.2% between 2004 and 2008 in a large cross-sectional study conducted in 24 countries[7], and kept increasing from 2008 to 2014 in a descriptive study covering 2865 countries in mainland China's 31 provinces[3]. Every coin has two sides, overuse of CS increases the risk of deputy injury, severe complications and adverse outcomes of subsequent pregnancy, and incidence of a twice CS at the same time[2, 3, 8].

External cephalic version (ECV) is an operation in which the baby's head was turned downward with the pressure on the mother's abdominal wall, which increases the chance of cephalic presentation at the onset of labor and decreases the CS rate by almost 40%[8, 9]. ECV had been highly recommended by the American College of Obstetricians and Gynaecologists and the Society for Maternal-Fetal Medicine in 2014, that every women with an uncomplicated breech pregnancy at term should be offered an ECV[10]. Besides, it has been estimated that ECV trial is cost-effective when compared to a scheduled CS for breech presentation if provided the probability of successful ECV is more than 32%[11]. For decades, ECV has been carried out in many medical institutions domastic and overseas, and the reported success rates of ECV ranged from 35–86%[8, 9, 12, 13]. In the present study, a retrospective experiences analysis with high ECV success rate of 90.58% in a tertiary hospital in Northest China was recorded and the variables associated with the success rate of ECV were detailedly analyzed.

As reported, many ancillary managements have been used to increase the success rate of ECV, including vibroacoustic stimulation, moxibustion, amnioinfusion, neuraxial analysis and tocolytic agents[6, 14–17]. Among them, beta stimulants and epidual analgesia have been proved to effectively improve the ECV success rate in Cluver's meta-analysis[11]. However, the data on comparision of the efficiency and side effects of the tocolytic agents was still lack. Terbutaline and ritodrine were applied as tocolytic agents during our procedures empirically. In pursuit of rationality, in this study, a bayesian network meta-analysis was conducted to compare the effects of variant tocolytic agents on the success rate and vaginal delivery rate of ECV, along with the common complications of tocolytic agents for the first time.

Material And Methods

Retrospective analysis of our ECV experiences

A retrospective analysis of 84 patients who underwent ECV at Dalian Maternal and Child Health Care Hospital from April 2017 to November 2019 was conducted. Healthy women near or at term (≥ 36 weeks) without severe complications, who were confirmed as breech presentation through ultrasonography, were considered as candidates for ECV. Patients who have history of placental or cord anomalies, severe pre-eclampsia or HELLP syndrome, premature rupture of membrane, vaginal bleeding less than seven days before ECV, prior uterine operation, intrauterine growth restriction or other fetal anomaly, oligoamnios, hyperextended fetal head and non-reassuring fetal monitoring were excluded. Oligoamnios was defined as amniotic fluid index less than eighty centimeter. And successful external cephalic version was defined as fetal cephalic presentation immediately following the procedure. Informed, ethic consents were obtained for all of the included patients.

Basic information was recorded, including the patients' age, operation time, gestational weeks at operation, parity, height, weight, tocolytic agents and doses, anaesthetic drugs and doses, placental location, breech type, presence of cord neck and amniotic fluid index. Electric fetal monitoring was used to check fetal condition.

We informed the risks of the operation, including fetal distress, failure of the procedure and possibility of emergency cesarean section to the candidates of ECV. Then the patients who signed the informed consents were prepared for ECV. It is noteworthy that all the included women were prepared for emergency surgery and remained fasting state before the procedure. ECV was all performed by a single chief obstetrician in our hospital. The patients were in supine position. Electric fetal monitoring and ultrasonography were performed before and after the ECV procedure to monitor fetal condition and position. All patients accepted continuous epidural anesthesia (CEA). Besides, patients were all infused with terbutaline (0.25 mg, intravenously) as the tocolytic agent before the procedure. The obstetrician push fetal buttock toward maternal head by the right hand and the left hand pull the fetal head downward when the patients' heart rate increased about 20 bpm. If fetal bradycardia was discovered, the operation was stopped until fetal heart rate recovered, otherwise, emergency cesarean section was performed. And the operation was considered as successful if the fetal head was located in the maternal pelvis after the procedure. Bellybands were used to maintain the fetal position until delivery. Only after confirming maternal and fetal condition with electric fetal monitoring and ultrasonography, patients were discharged. If not, patients were kept in hospital or emergency cesarean section was performed. The delivery information of patients undergoing ECV were also collected, including gestational age at delivery, way of induced labor, delivery mode, vaginal bleeding volume, amniotic fluid volume, umbilical condition, maternal complications, weight and Apgar score of the baby.

Patient information was described as mean and standard deviation for continuous variables, proportions for categorical variables. Differences of variables between groups were assessed by the Mann-Whitney U test for continuous variables, and the Chi square test and Fisher's exact test for categorical variables. Multivariable logistic regression analysis was used to evaluate factors independently connected with the success of ECV. All reported tests were two-sided and P-value < 0.05 was set as the cut-off criterion for statistically significant. All statistical analysis was performed with IBM SPSS version 22.0 (IBM Corp, Armonk, NY, USA).

Network Meta-analysis Of Tocolytic Agents

At the same time, a bayesian network meta-analysis was performed for the tocolytic agents of ECV with the current eligible randomized controlled trials (RCTs). Pubmed (http://www.ncbi.nlm.nih.gov/pubmed), the Cochrane Library (http://www.cochranelibrary.com) and Embase (http://www.embase.com) databases were searched to discover eligible studies published before May 20, 2019. The research terms were "Breech presentation", "Breech", "External cephalic version", "ECV", "Version fetal", "Tocolytic agent",

“Uterine relaxation”, and which were MeSH terms or text words. And the search strategy applied to PubMed was listed as below:

#1 Breech presentation[Mesh]

#2 Breech[tw]

#3 (#1) OR # 2

#4 External cephalic version[Mesh]

#5 ECV[tw]

#6 Version fetal[tw]

#7 ((#4) OR # 5) OR #6

#8 Tocolytic agent[Mesh]

#9 Uterine relaxation[tw]

#10 (#8) OR #9

#11 ((#3) AND #7) AND #10

Inclusion criteria: (1) Patients with breech presentation received ECV. (2) Interventions were different tocolytic agents or placebo. (3) The research type was randomized controlled trial (RCT). (4) The studies should provide the success rate of ECV. (5) The published language was English. Exclusion Criteria: (1) Patients were given more than one type of tocolytic agent. (2) No full text of articles or duplicate studies were identified. And the following data was collected: author, year of publication, sample size, tocolytic agents, number of patients with successful ECV.Besides, risk of bias of the included RCTs was evaluated with the Cochrane Collaboration’s ‘Risk of bias’ tool.

The quality of the included studies was assessed based on the potential source of bias as follows: (1) Random sequence generation (selection bias); (2) Allocation concealment (selection bias); (3) Blinding of participants and personnel (performance bias); (4) Blinding of outcome assessment (detection bias); (5) Incomplete outcome data (attrition bias); (5) Selective reporting (reporing bias); (5) other bias. And trials with an overall score of 10/12 were graded as “low risk”, equal to or less than 6/12 were graded as “high risk”. Data extraction and quality assessment were conducted by two independent investigators (Yunyun Xiao and Wei Zhao). The disagreement was assessed by a third investigator.

The network analysis comparing various tocolytic agents was conducted by random-effect model within a Bayesian framework. ORs (odds ratios) and corresponding 95% credible intervals (Crls) were calculated by Markov chain Monte Carlo methods through the 0.8.2 “gemtc” package of R software (version 3.6.1; R Foundation, Vienna, Austria). This method combined with both direct and indirect evidence for the given

pair of treatments and assigned endpoints. Function of mtc.run was employed to generate samples and 5,000 simulations for each chain were set as the “burn-in” period, then 20,000 iterations were brought to obtain the OR of model parameters, when four Markov chains run simultaneously. In the meantime, Brooks-Gelman-Rubin plots method, trace plot and density plot were used to access the model convergence. Besides, rank probabilities would be calculated to obtain the hierarchy of each treatment and the matrix as well as the plot of rank probabilities was provided by the “gemtc”package simultaneously. The node-splitting method was used to evaluate the consistency and inconsistency of the model. The values of $I^2 > 50\%$ were considered to show heterogeneity across the trials.

Results

Retrospective analysis of our ECV experiences

Among 84 ECV operations, 76 (90.48%) successed and only 8 (9.52%) failed. Detailed information of the 84 patients was shown in Table 1. Mean maternal age was 31.50 years in total. In detail, 31.63 years in the successful team and 30.25 years in the failed group (P = 0.339). The mean gestational age was 37.01weeks, 37.02 weeks and 37.01 weeks in total, successful and failed group, respectively. The proportion of multiparous women was higher in successful group than in failed group (40.79% vs 12.5%), but not statistically significant (P = 0.117). The women in successful group were not with obviously different with those patients in failed group on stature, with BMI 25.37 vs 25.02 (P = 0.903). Ultrasonographic findings of placental location, presentation and umbilical cord around neck of fetus are also collected, results were delineated in Table 1. As the results shown, proportion of posterior placenta location in the successful group was obviously higher than the failed group (61.84% vs 37.5%, P = 0.029). And as compared with women in failed group, those in successful group had higher amniotic fluid index (AFI) value (137.92 vs 100.38, P = 0.001). Only one patient was performed with a second time of ECV among all the included women due to recovery of breech presentation after a period of loose of the belly band. We considered the variables, such as, maternal parity (multiparous), AFI, placental location (posterior), fetal breech presentation type (frank)in ECV, which might determine the success or failure of ECV. Then through multiple logistic regression analysis of these factors, AFI were separately found to affect the success of ECV (HR = 0.965, 95%CI:0.937–0.995, P = 0.021) with our data. And 84.52% patients were anesthetized with chloroprocaine. Others accepted ropivacaine, also with no statistical meaning.

The delivery information of the 84 included women was obtained, as shown in Fig. 1. The 76 patients with successful ECV all came through smooth delivery. One had CS because the fetus reverts to breech presentation. Among 46 patients with spontaneous labour, 44 patients had vaginal deliveries, 2 patients had cesarean section because of rupture of the placental marginal sinus and protracted descent. Among 29 patients with induced labour, 23 patients had vaginal deliveries, 6 patients had cesarean section, two were due to intrauterine infection, one was because of failure of induction, one was owing to protracted descent and two was on account of fetal distress. Another 8 failed ECV women, 5 had emergency CS,

four were due to fetal bradycardia, one was because of placental abruption. Other 4 had elective cesarean delivery with persistent breech presentation on termination of pregnancy.

Other information of patients at delivery was also obtained and listed in Table 2. Obviously and reasonably, gestational age of patients with successful ECV was higher than patients with failed ECV, same to birth weight of the fetuses. Only one woman underwent successful ECV delivered with premature infant's Apgar score of 8, and the neonate was admitted into NICU. Apgar score of others were all 10, but one fetus was admitted into NICU because of hypoglycemia. Complications within 24 h between the two groups were significantly different (10.53% vs 62.5%, P = 0.005). Five patients had transient fetal brachycardia in successful ECV group, and they were discharged with satisfied FHR monitoring. In the group of failed ECV, 4 patients had fetal brachycardia. After informing the conditions to the family, they requested emergency CS. Another 2 patients also accepted emergency CS, one was because of rupture of placental marginal sinus after successful ECV and one was because of placental abruption. The babies were both with apgar score of 10. As for other complications during pregnancy, including PROM, GDM, DM, hypothyroidism and hypertension, incidence between the two groups were not statistically variant.

Result Of The Bayesian Network Meta-analysis

Through literature retrieve with the descriptive search strategy, 492 studies were found. Amongst them, 432 records were excluded because of incongruent content, case-reports, reviews, meta-analysis or duplicates based on the titles and abstracts. Then, 38 studies were excluded on account of case-control studies, cohort studies or not comparing tocolytic agents during ECV process after reading the full articles. Besides, 6 records were removed owing to repetitive administration of different tocolytic agents to one patient. Finally, 16 RCTs[18–33]with 3468 patients were included in our study, details of the studies were summarized in Table 3. And the common adverse effects of the tocolytic agents were shown in Table 4. The workflow is shown in Fig. 2. All of these eligible records were RCTs and the quality of evidence was evaluated by the cochrane Handbook scoring system, and potential bias was graded as high, low or unclear. The detailed results of the evaluation were shown in Fig. 3a,b. Network meta-analysis was conducted based on the clinical outcomes, including ECV success, vaginal delivery and common complications of tocolytic agents retrospectively.

The 16 enrolled studies contains 3 kinds of tocolysis, beta stimulants (salbutamol, ritodrine and terbutaline), calcium channel blockers (nifedipine) and nitric oxide donors (nitroglycerine). They were compared in pairs or contrasted with placebo. Besides, as terbutaline was the most common tocolytic agent clinically, other drugs and placebo were also compared with it. According to variant treatments, the networks were plotted and the results were shown in Fig. 4a,b and c. The thickness of the connective lines were proportional to the number of comparisons, and the numbers were shown on the lines. No inconsistency was found between the direct and indirect comparisons from node-splitting analysis.

Success Of Ecv

The included 16 studies all recorded success and failed number of patients after ECV under the usage of different tocolytic agents or placebo. And the highest success rate is 70.18%, which was under the treatment of salbutamol in Vani's study. The lowest success rate is 0.8%, which was under the treatment of placebo in Impey's study. The efficacy of other tocolytic agents and placebo versus terbutaline, and different tocolytic agents versus placebo on the success rate of ECV were evaluated by ORs and corresponding 95% CrIs (As displayed in Fig. 5a, b). And the rank probabilities of the different treatment strategies were shown in Fig. 6a. Accordingly, it isproved that terbutaline played better roles on ECV success rate than nifedipine (OR 0.53, 95% CrI 0.31 to 0.96), nitroglycerin (OR 0.44, 95% CrI 0.21 to 0.91), and placebo (OR 0.46, 95% CrI 0.24 to 0.93), but comparable with ritodrine (OR 0.79, 95% CrI 0.38 to 1.8) and salbutamol (OR 1.2, 95% CrI 0.47 to 3.0). When compared with placebo, ritodrine (OR 1.7, 95% CrI 1.2 to 2.6), sabultamol (OR 2.5, 95% CrI 1.4 to 4.7) and terbutaline (OR 2.1, 95% CrI 1.1 to 4.2) were identified to exert positive effect on ECV success rate, but nifedipine (OR 1.1, 95% CrI 0.63 to 2.1) and nitroglycerin (OR 0.94, 95% CrI 0.56 to 1.6) didn't work better.

Vaginal Delivery

A total of 13 studies reported delivery condition of the included participants, with the highest vaginal delivery rate of 86.05% under the treatment of nifedipine in Ismail's study and the lowest vaginal delivery rate of 14.51% under the treatment of placebo in Impey's study. The efficacy of other tocolytic agents or placebo versus terbutaline, and different tocolytic agents versus placebo on the vaginal delivery rate were evaluated by ORs and corresponding 95% CrIs (As shown in Fig. 5c,d). And the rank probabilities of the different treatment strategies were shown in Fig. 6b. As the result showed that terbutaline didn't work better obviously on vaginal delivery rate than other treatments. Besides, application of the tocolytic agents didn't significantly improve the vaginal delivery rate compared with placebo. However, ORs of nitroglycerin (OR 1.4, 95% CrI 0.78 to 2.7), ritodrine (OR 1.4, 95% CrI 0.85 to 2.3), salbutamol (OR 1.4, 95% CrI 0.57 to 4.4) and terbutaline (OR 1.6, 95% CrI 0.83 to 3.5) were all above one compared with placebo, except for nifedipine (OR 0.98, 95% CrI 0.50 to 2.1).

Common Complications Of Tocolytic Agents

Eight studies recorded the incidence of common complications. ORs and CrIs used to evaluate the influence of the treatments on the emergency of common complications were displayed in Fig. 5e, f. Rank probabilities of the interventions were exhibited in Fig. 6c. Comparing with terbutaline, salbutamol (OR 8.4e + 06, 95% CrI 5.1 to 2.4e + 25) appeared evidently more complications, other interventions all had ORs less than one, but not with statistical meaning. Compared with placebo, sabutamol also had more complications (OR 1.6e + 08, 95% CrI 14 to8.8e + 21), terbutaline (OR 2.1, 95% CrI 0.27 to 14), nifedipine (OR 1.8, 95% CrI 0.29 to 10) and nitroglycerin (OR 1.7, 95% CrI 0.39 to 5.4) all had ORs lager than one, ritodrine (OR 0.92, 95% CrI 0.12 to 4.7) had OR less than one, but is not statistically significant.

Discussion

In this study, we mainly investigated the characteristics of the candidates and interventions which could increase the success rate of ECV but with lower risk of complications. And the research was conducted based on a retrospective analysis with our own experiences and a bayesian network meta-analysis with the published RCTs on different tocolysis and placebo. ECV has been performed since the time of Hippocrates[34]. It was always tried before term prior to mid-1970s owing to the idea that the procedure would seldom be successful at term[35-37]. Whereas, the popularity of ECV before term became on the wane after mid-1970s on account of the high perinatal mortality, such as preterm rupture of the membranes, preterm labour, placental abruption and feto-maternal transfusion associated with the procedure[36]. Succeeding studies since 1980s showed that successful ECV could be accomplished in term breech pregnancies with low risk of complications[2]. Then various RCTs had proved that ECV performed near or at term could obviously reduce the incidence of noncephalic births and cesarean delivery rate for malpresentation[36,38]. And the practice guidelines made in the recent years also suggest offering ECV at or near term[6,39]. So the gestational week of all included candidates for ECV were greater than 36 weeks in the present study.

It is worth mentioned that the success rate of ECV reached 90.48% in our study, which was higher than the reported data. And the experiences during the procedure about how to achieve high success rate of ECV deserved to be concluded. We conclude that factors influencing the success rate of ECV mainly include: 1. characteristics of the mothers and fetuses, 2. interventions, 3. skills of the surgeon.

Firstly, in our opinion, proper selection of the candidates was the most important, including the condition of the mothers and fetuses. Variables such as parity, age, body mass index and uterine tension of the mothers, type of breech, placental location, amniotic fluid index, estimated fetal weight, cord rounds and palpation of the fetal head of the fetuses were reported to be associated with the success rate of ECV[13]. Among all the observational factors, higher AFI was found to be associated with higher success rate of ECV with our data, no matter through single or multi-factor analysis. And AFI was set as the preferred indicator for us to select the patients to offer an ECV if their gestational age meet the requirement. We really agree that ECV should be avoided in cases of oligohydramnios as the guidelines stated. However, average AFI was 137 in the successful group and 100 in the failed group in our study, which pointed that higher level of AFI should be set as the inclusion criteria for ECV, not just over 80. Even so, it is really hard to discover the specific selection level of AFI, and there are still no relevant RCT studies in the current time. It is worth mentioning that though amnioinfusion and oral hydration could improve the amount of amniotic fluid, which could not obviously improve the success rate of ECV[14,40]. Stature of the candidates was the second important indicator to select the candidates during our procedure, because thickness of the abdominal wall directly affect the difficulty of grasping of the fetal head and buttocks[41,42]. BMI of the patients ranged from 21.5 to 31.6 in our study, with no difference between the successful and failed group, which might due to the strict screening criteria in our institution. As for other factors, multipara, frank breech presentation, posterior placenta were also considered as positive influence indicator for the feasibility of ECV, and which were ranked from high to low scores in a semi-

quantitative review with 214 references. Posterior placenta was proved to be associated with the success rate of ECV[47]. Other factors were not statistically meaningful among our patients, which might be associated with the limited participants in our study. Above all, a more strict and explicit inclusion and exclusion criteria. Especially the value of AFI and BMI worth being affirmed. Furthermore, a more detailed scoring standard according to the possible influence indicators of the mothers and fetuses for the feasibility of ECV should be set up, which was critical for the worldwide popularization and specification of ECV. In the future, we will conduct prospective studies on this issue.

Secondly, proper interventions during the process of operation were essential. Tocolytic agents (terbutaline and ritodrine) and epidual analgesia were applied to improve the success rate of ECV in our affiliation. As reported, various interventions had been used to improve the success rate of ECV, including tocolytic agents, vibroacoustic stimulation, regional analgesia, amnioinfusion, systemic opioids, hypnosis and talcum powder[9]. However, only beta stimulants were proved to be effective during ECV procedure in the meta-analysis based on frequency distribution of different interventions. But comparisons of the effectiveness and complications of different tocolytic agents were still undiscovered. Therefore, a bayesian-network meta-analysis included 16 RCTs[18-33] was conducted to compare the efficiency of five common tocolysis on success rate of ECV and vaginal delivery rate, and the common complications of five tocolytic agents in our study. As is shown, terbutaline, salbutamol and ritodrine played better roles than nitroglycerine and nifedipine on the success rate of ECV, but they are not different on vaginal delivery rate. As for the common side effects of the tocolytic agents, including tachycardia, palpitation, hypotension, nausea, dizziness, flushes and abnormal FHR, salbutamol was found to have more complications than other ones. Thus, it is reasonable for us to select terbutaline and ritodrine as the tocolytic agents during ECV procedure. As for analgesia, a meta-analysis included 9 RCTs concluded that regional analgesia could significantly increase the success rate of ECV and the vaginal delivery rate[43]. Besides, it has been proved that regional analgesia combined with tocolytic agents was more effective than the tocolytic agents alone for increasing the success of ECV[9]. Vibroacoustic stimulation, systemic opioids and hypnosis were just applied among quite a small part of patients, which were not well studied. Talcum powder or gel is in common use in certain countries, including Malaysia and Australia, which could obviously reduce the pain of the patients, especially under the circumstance of no analgesia[27]. But there were still no report about the solely influence of talcum powder or gel on the success rate of ECV. All in all, it is reasonable for us to apply terbutaline, ritodrine and epidual analgesia to improve the success rate of ECV during our procedure.

Thirdly, the experience of the operator was also an important factor influencing the outcome of ECV, but could not be measured numerically. As proved, the success rate of ECV was connected with the medical level of the hospital, which was ranged from 8.2% to 83.6% in different hospitals in a research of 4770 women from 36 hospitals[44]. Last but not least, application of the bellyband after successful version was of great help in our experience, which could reduce the incidence of reversion of the cephalic presentation.

In summary, the overall CS rate was 20.24% in the present study, in which the emergency CS rate was 5.95%, mainly because of transient fetal heart rate, a case of placental abruption also occurred and which was also the most serious complication of ECV. Intrapartum CS rate in our study was 9.52%. And the previously recorded intrapartum cesarean delivery rates after successful ECV have been reported to range from 8% to 31%[44], which might be influenced by individual judgement in different hospitals. A meta-analysis published in 2004 concluded that intrapartum CS rate after successful ECV was two times of that spontaneous cephalic pregnancies[45]. Isakov et al compared the delivery condition of 47 patients accepting successful ECV and 7456 patients with spontaneous cephalic presentation, which also found that the prior had higher cesarean delivery rate (27.7% vs 12.8%)[46]. It should be noteworthy that pregnancies after successful version should not be considered the same as a normal pregnancy. Therefore, it is essential to re-evaluate the conditions of the patients after successful versions when the patients were about to give birth. Not each patient suffered from successful version was suited for vaginal delivery.

Furthermore, there are also several limitations of our research. First, this is a retrospective analysis with only Eighty-four patients. Second, the procedure was conducted by one obstetric physician in a single tertiary center. Third, though the study type of all the included studies in the network meta-analysis was RCTs, the method and dose of administration were not completely consistent. Nevertheless, Velzel et al identified that success rate of ECV was not associated with the dose of salbutamol (0.1-0.4mg). Thus, the real value of the current results still worth verifying with more larger sample size RCTs.

Conclusion

ECV is a safe procedure for term or near term breech presentation women, which could obviously reduce the cesarean section rate and increase vaginal delivery rate. We conclude that factors influencing the success rate of ECV mainly include: 1. characteristics of the mothers and fetuses, 2. interventions, 3. skills of the surgeon. During ECV process, the condition of the mothers and fetuses affect the success rate of ECV to a great extent. Therefore, exploration of explicit inclusion and exclusion criteria were of great importance, especially about AFI and BMI. Besides, a more detailed scoring standard according to the possible influence indicators of the mothers and fetuses for the feasibility of ECV should be set up. As for interventions of ECV, tocolytic agents (terbutaline and ritodrine) and epidual analgesia should preferentially be recommended for ECV procedure. Application of bellybands was pointed out beneficially to the maintaining of cephalic presentation after successful ECV in our own experiences. In addition to human interventions, patients' awareness of self-management is also significant, including keeping good stature, drinking more water and walking more.

Abbreviations

ECV
external cephalic version
CS

cesarean section
AFI
amniotic fluid index
RCT
randomized controlled trial

Declarations

Acknowledgments

No

Conflicts of interests

The authors have declared that no competing interest exists.

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Ethical approval

Ethics approval was granted by the local ethics committee.

Informed consent

Patients who received external cephalic version all signed the informed consents.

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Figures

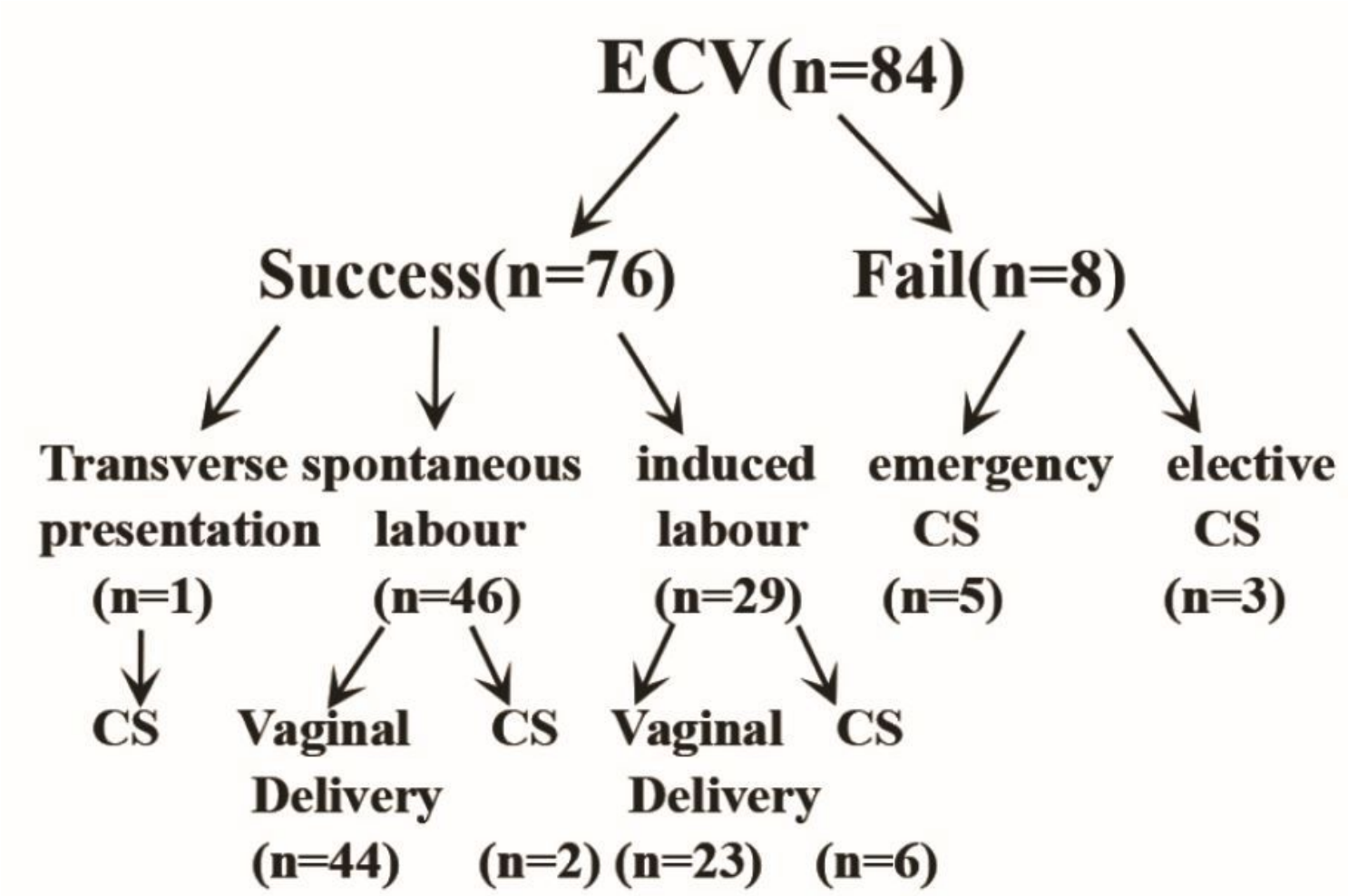

Figure 1

Workflow of the outcomes of the patients underwent external cephalic version.

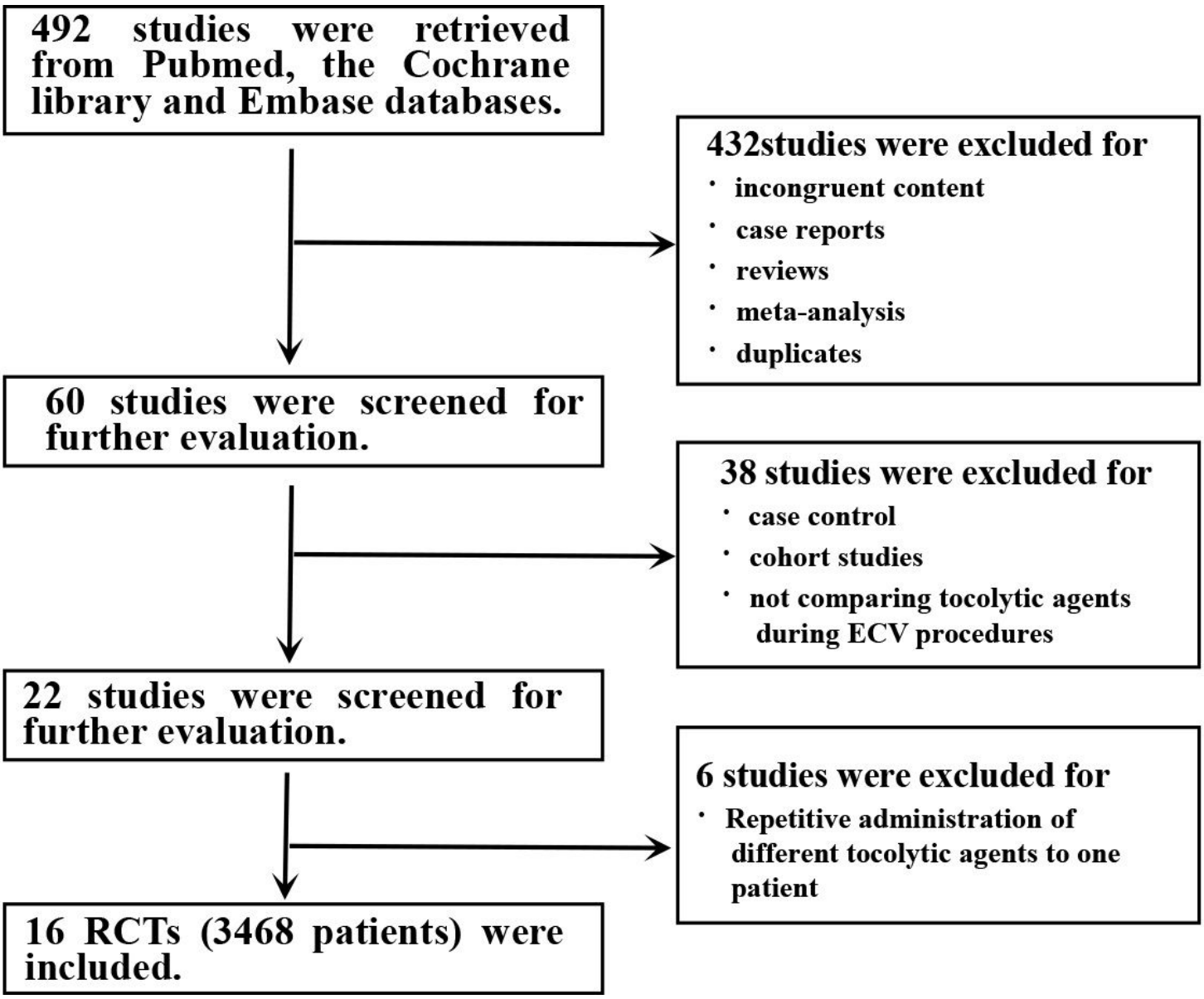

Figure 2

. Flow chart of the included studies.

Figure 3

Risk of bias summary. a. Review author's judgement for each risk of bias item for the included studies. b. Review author's judgement for each risk of bias item presented as percentages of all included studies.

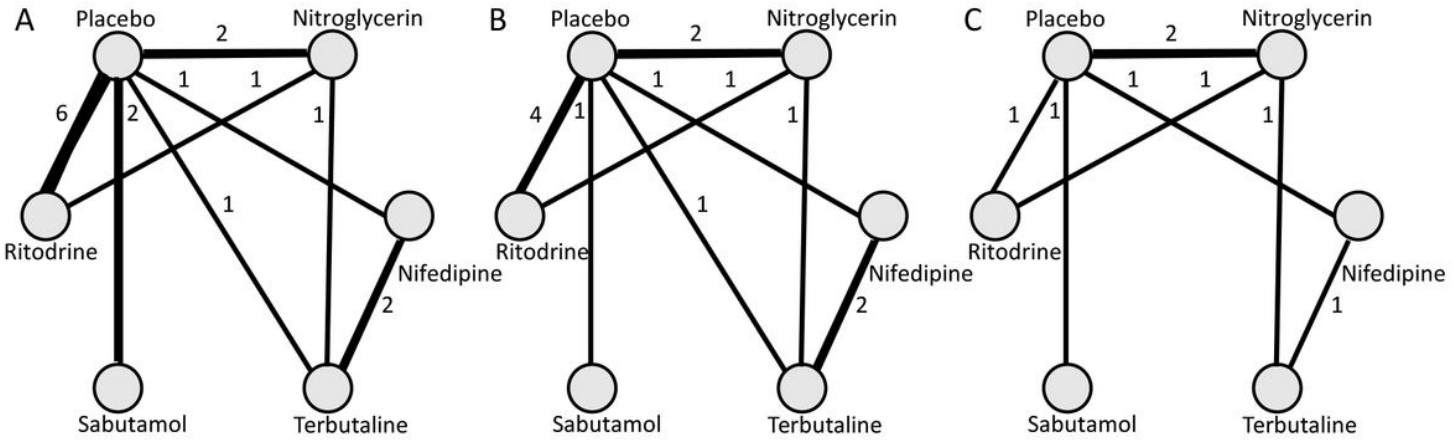

Figure 4

Network structure diagrams. a. Success rate of external cephalic version. b. Vaginal delivery rate. c. Complications of the tocolytic agents. The thicknesses of the lines were proportional to the number of comparisons.

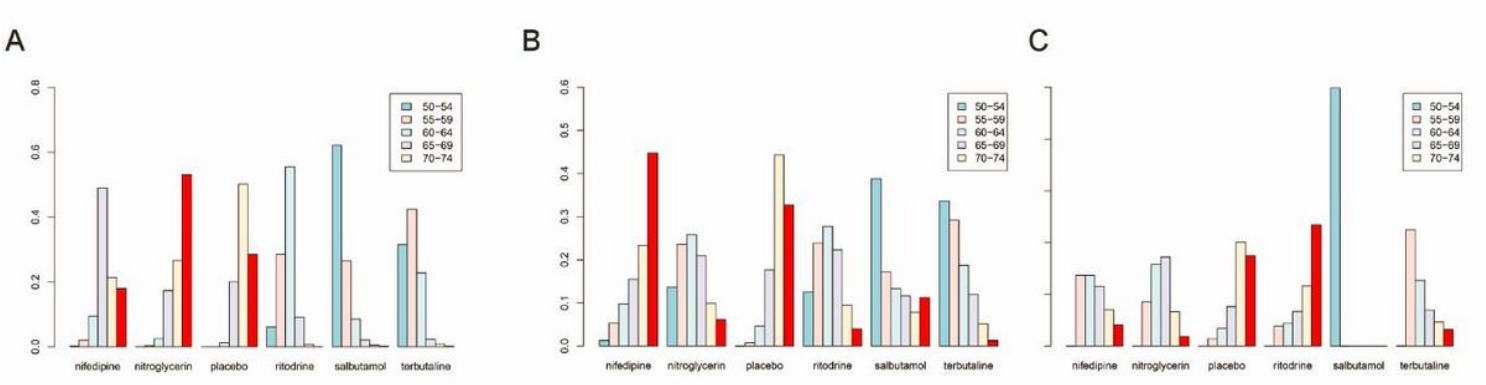

Figure 5

The efficacy of different tocolytics. a. The efficiency of other tocolytics and placebo compared with terbutaline on success rate of external cephalic version. b. The efficiency of different tocolytics compared with placebo on success rate of external cephalic version. c. The efficiency of other tocolytics and placebo compared with terbutaline on vaginal delivery rate of external cephalic version. d. The efficiency of different tocolytics compared with placebo on vaginal delivery rate of external cephalic version. e. The incidence of complications of other tocolytics and placebo compared with terbutaline. f. The incidence of complications of different tocolytics compared with placebo.

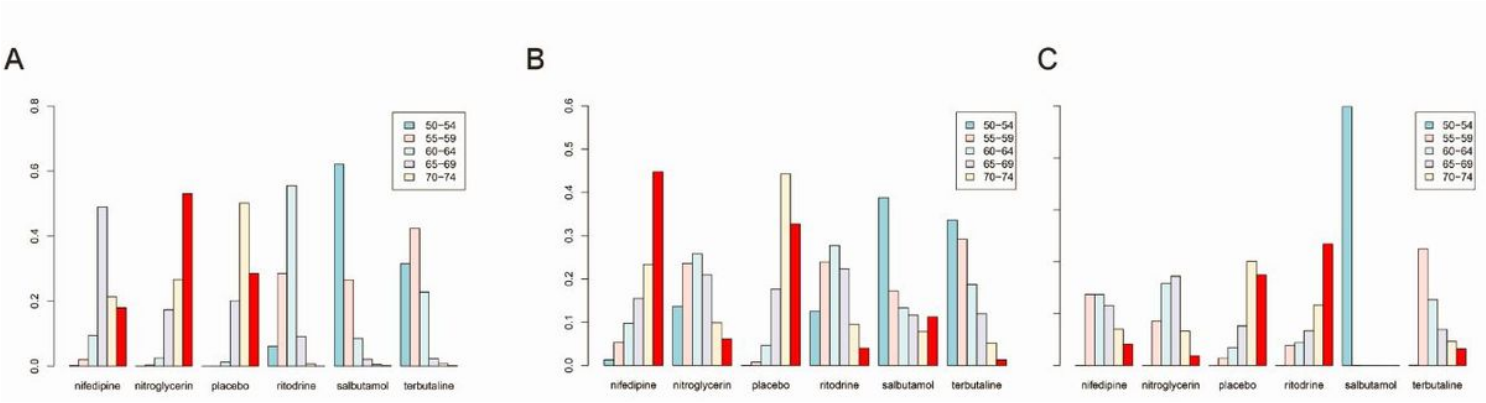

Figure 6

Detailed rank probability. a. Rank probability of success rate of external cephalic version. b. Rank probability of vaginal delivery rate. c. Rank probability of complications of different tocolytics.

Supplementary Files

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