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Effect of Regional Anesthesia on the Success Rate of External Cephalic Version: A Systematic Review and Meta-Analysis

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Abstract

Objective—To estimate whether the use of regional anesthesia is associated with increased success of external cephalic version.

Data Sources—We searched Medline, EMBASE, the Cochrane Library, and clinical trial registries.

Methods of Study Selection—Electronic databases were searched from 1966 through April 2011 for published, randomized-controlled trials (RCTs) in the English language comparing regional anesthesia to no regional anesthesia for external cephalic version. The primary outcome was external cephalic version success. Secondary outcomes included cesarean delivery, maternal discomfort, and adverse events. Pooled risk ratios (RR) were calculated using a random-effects model. Heterogeneity was assessed using the Cochran's Q statistic and quantified using the I² method.

Tabulation, Integration, and Results—Six RCTs met criteria for study inclusion. Regional anesthesia was associated with a higher external cephalic version success rate compared to intravenous or no analgesia (59.7% vs. 37.6%; pooled RR 1.58, 95% confidence interval [CI] 1.29-1.93). This significant association persisted when the data was stratified by type of regional anesthesia (spinal vs. epidural). The number needed to treat with regional anesthesia to achieve one additional successful ECV was 5. There was no evidence of statistical heterogeneity ($p=0.32$, $I^2=14.9\%$) or publication bias (Harbord test $p=0.78$). There was no statistically significant difference in the risk of cesarean delivery comparing regional anesthesia to intravenous or no analgesia (48.4% vs. 59.3%; pooled RR 0.80, 95% CI 0.55-1.17). Adverse events were rare and not significantly different between the two groups.

Conclusion—Regional anesthesia is associated with a higher success rate of external cephalic version.

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Introduction

Breech presentation occurs in 3-4% of singleton pregnancies at term.¹ Given concerns regarding short-term neonatal morbidity and diminishing provider experience in vaginal breech delivery, cesarean delivery for breech presentation is the preferred mode of delivery.^{2,3} External cephalic version (ECV) offers a potential alternative to elective cesarean delivery for breech presentation. The American College of Obstetricians and Gynecologists (ACOG) currently recommends that ECV be offered to all women near term with a fetus in breech presentation.¹ While the average overall success rate for ECV is approximately 58%, there is wide variation in this estimate.¹

Multiple factors have been proposed to be associated with ECV success, including provider experience, type of breech presentation, parity, amniotic fluid index, maternal weight, placental location, and fetal weight.⁴⁻⁸ Furthermore, tocolytic agents and regional anesthesia have been used in attempts to maximize the success rate of this procedure. In 2004, the Cochrane Collaboration performed a systematic review and meta-analysis of the literature regarding the use of interventions to improve the success of ECV for breech presentation at term. The authors concluded that while there is evidence to support the use of tocolytics to reduce the failure rate of ECV at term, regional anesthesia could not be recommended given the conflicting results of the studies included.⁹ Since the Cochrane report, additional randomized controlled trials (RCTs) have been performed to evaluate the efficacy of regional anesthesia as an intervention to increase ECV success rates.¹⁰⁻¹² These subsequent studies by themselves have produced inconclusive evidence to guide the use of this intervention.

The objective of this study was to systematically review the literature for relevant studies comparing the use of regional anesthesia to no regional anesthesia in ECV attempts at or near term in singleton gestations. We also sought to conduct a meta-analysis of these studies to obtain a summary estimate of the effect of regional anesthesia on the success of ECV.

Sources

An a priori protocol was developed which outlined the search strategy, study inclusion criteria, outcomes, and methods of data abstraction and synthesis. A search for all available RCTs was conducted using Medline, EMBASE, the Cochrane Library, and clinical trials registry from 1966 through April 2011 by two independent investigators. (K.G. & L.H.) The search was performed using the MESH headings “version, fetal” and “anesthesia, obstetrical”, “anesthesia, epidural”, “anesthesia, spinal”, “anesthesia, injections”, and “analgesia, epidural”. All fields were also searched using the terms “external cephalic version” and “regional anesthesia”, “spinal”, “epidural”, and “analgesia.” Research results were limited to published RCTs in the English language. Unpublished studies, non-English language articles, abstracts, observational studies, case series, case reports, and case commentaries were excluded. Titles and abstracts identified from the initial search were screened to determine if the studies met inclusion criteria. Citation lists of retrieved articles were also manually searched to further identify relevant studies. To have met inclusion criteria, the study must have been a randomized controlled trial comparing the use of regional anesthesia to no regional anesthesia for external cephalic version at a gestational age of 36 weeks or greater.

Study Selection

Each eligible article meeting the inclusion criteria was reviewed by two independent reviewers (K.G. & L.H.), and the following data was extracted: year of publication, eligibility criteria, total number of patients, type of regional anesthesia, type of anesthesia in

the control group (none vs. intravenous analgesia), median gestational age at version in both the regional anesthesia and control groups, use of tocolytics, type of hospital (university vs. community), number of successful ECVs, number of Cesarean deliveries, assessment of maternal discomfort and method of assessment, and adverse events including placental abruption, transient fetal bradycardia, terminal bradycardia, and need for emergent Cesarean section. Quality of each study was assessed based on method of random allocation and use of intent-to-treat analysis.

The primary outcome was successful ECV, defined as successful manipulation of the fetus from breech to vertex presentation confirmed by ultrasound. Secondary outcomes of interest included cesarean delivery, maternal discomfort, and adverse events during and immediately following the procedure.

Data Synthesis

Meta-analysis was performed using STATA 10.1, Special Edition (College Station, TX). Between-study statistical heterogeneity was assessed using the Cochran Q statistic and was quantified using the I^2 method. We then calculated pooled relative risks (RR) and 95% confidence intervals (CI) for the outcomes of interest using a random-effects model even when there was no evidence of statistical heterogeneity. This more conservative random-effects model was chosen given the possibility of clinical heterogeneity between studies, regardless of the finding of statistical heterogeneity. Publication bias was assessed using funnel plots, and the Harbord test. We performed planned sensitivity analysis which involved removing individual studies, one at a time, and repeating the meta-analysis to determine the influence of each study on the pooled RRs and 95% CIs. We used meta-regression to estimate the percent of heterogeneity in the primary outcome attributable to the type of regional anesthesia used.

A qualitative synthesis was performed for studies which reported data on maternal discomfort during the procedure and the adverse events of emergent Cesarean delivery, terminal fetal bradycardia, and placental abruption. Formal meta-analysis was not performed for these outcomes given the overall rarity of these adverse events and the variability in measurement of maternal discomfort across studies.

Results

An initial search identified 117 articles. After excluding duplicates (75), observational studies (9), case series (2), case reports (6), meta-analyses (6), reviews (11), and abstracts (2), six published RCTs met inclusion criteria (Figure 1). Searching the bibliographies did not reveal any additional results. One ongoing randomized trial was noted in the clinical trials registries. Characteristics of the included studies are shown in Table 1. A total of 253 external cephalic versions were attempted with regional anesthesia and 255 attempted with intravenous or no analgesia.

Critical appraisal of the studies showed good quality of all the studies included. All studies reported acceptable methods of randomization and concealment allocation. While all studies appeared to follow an intention to treat analysis, this was only formally reported in the Methods section of three studies.¹⁰⁻¹² No studies blinded clinician or patient to allocation group due to the inherent inability to blind to the presence or absence of regional anesthesia. Furthermore, each study described eligibility and exclusion criteria, had comparable baseline characteristics of the study groups, and reported point estimates with measures of variability. All studies were single-center and were performed at university hospitals. Additionally, tocolytic agents were used during ECV attempts in all studies. Data on specific aspects of study quality as well as trial details are shown in Table 2.

All six studies reported on the primary outcome of successful ECV. From the meta-analysis, regional anesthesia was associated with a 58% increase in the rate of successful version (59.7%) compared to no regional anesthesia (37.6%) (RR 1.58, 95% CI 1.29-1.93). (Figure 2) The associated number needed to treat was 5; in other words, 5 additional epidurals were needed for one more successful version. Because the number needed to treat is sensitive to the underlying rate of successful version, we varied the baseline rate of success. For example, the number needed to treat at centers with baseline ECV success rates of 50% and 60% would be 4 and 3, respectively.

There was no evidence of statistical heterogeneity among studies ($p=0.32$, $I^2=14.9\%$). Additionally, both visual inspection of the funnel plot and the non-significant results of the Harbord test ($p=0.78$) suggest the absence of publication bias. (Figure 3) Finally, sensitivity analysis revealed no marked change in RRs and 95% CIs when individual studies were removed.

As the type of regional anesthesia used differed between studies, a meta-regression was performed to evaluate the effect of type of regional anesthesia on the primary outcome. Of the six RCTs included in the meta-analysis, three used spinal anesthesia, one used combined spinal-epidural (CSE) anesthesia, and two used epidural anesthesia. Meta-regression revealed that all of the 14.9% between-study heterogeneity observed in the primary outcome was explained by the type of regional anesthesia used. A stratified analysis based on type of regional anesthesia (spinal vs. epidural) was then performed to determine the pooled RR and 95% CI for each sub-group for the primary outcome. For the purpose of this stratified analysis, CSE anesthesia was included in the spinal anesthesia group. The chance of a successful ECV was almost 2-fold higher with epidural anesthesia (RR 1.91, 95% CI 1.29-1.93) compared to 1.5-fold higher with spinal anesthesia (RR 1.46, 95% CI 1.14-1.87).

Of the six RCTs, five studies reported mode of delivery following ECV attempt. A total of 105 out of 217 patients (48.4%) in the regional anesthesia group underwent cesarean delivery compared to 131 of 221 patients (59.3%) in the no regional anesthesia group. This difference was not statistically significant (RR 0.80, 95% CI 0.55-1.17). (Figure 4) There was evidence of significant statistical heterogeneity between studies for this outcome. ($p=0.002$, $I^2=76.5\%$)

Maternal discomfort or pain during the procedure was qualitatively assessed because the scales used and methods of reporting differed for all but two studies. In the three studies using a visual analog scale, the pain scale was consistently lower in the regional anesthesia group.¹⁰⁻¹² In the two studies reporting discontinuation of procedure secondary to maternal discomfort, only one procedure in the regional anesthesia group was discontinued compared to eight in the no anesthesia group.^{13,14}

Five studies reported adverse events, all including emergent cesarean delivery as an outcome.^{10-13,15} (Table 3) Together, there was only one emergent cesarean delivery in the regional anesthesia group and one in the control group, both of which were due to terminal fetal bradycardia. Four studies reported on transient fetal bradycardia during or after the procedure. Although there were more transient fetal bradycardia episodes in the regional anesthesia group compared to the no regional anesthesia group (23 vs. 15 events), this finding was not statistically significant. (RR 1.58, 95% CI 0.85-2.94) Occurrence of placental abruption was reported in five studies. There was only one placental abruption documented which was diagnosed at the time of cesarean delivery in a patient in the control group.

Discussion

The goal of ECV is to convert a breech presentation to a cephalic presentation in order to ultimately achieve a vaginal delivery, avoiding an indicated cesarean delivery for breech presentation. Several strategies have been employed to increase success rates of ECV including modifying the gestational age at version attempt, use of tocolytics, and use of regional anesthesia. Regional anesthesia is theorized to improve ECV success by relaxing the maternal abdominal wall and improving maternal tolerance of the procedure; however, there are concerns over increased risk of abruption and fetal injury from excessive force. Results of this systematic review and meta-analysis demonstrate that regional anesthesia is associated with an increased rate of successful ECV. The number needed to treat of five was highly favorable, implying that for every five patients receiving regional anesthesia, one additional version will be successful. Although adverse events were rare, there was no increased risk of transient fetal bradycardia, placental abruption or emergent cesarean delivery.

Results from our analysis stratified by type of regional anesthesia demonstrated that both spinal and epidural anesthesia were associated with increased ECV success. It is plausible that epidural anesthesia would be associated with increased success given that epidural involves placement of a catheter which provides the opportunity for medication re-dosing to achieve an adequate anesthesia block. Although epidural anesthesia was associated with an absolute higher increase in the rate of ECV success compared to spinal anesthesia (91% vs. 46%), this difference was not statistically significant given the overlapping confidence intervals.

Prior studies have demonstrated mixed results regarding the effect of regional anesthesia on ECV success. Schorr *et al.* demonstrated a 2-fold increase in the success of ECV comparing epidural anesthesia to control anesthesia.¹⁴ Similarly, Mancuso *et al.* demonstrated a 1.8-fold increase in the rate of ECV success with epidural anesthesia and a 2.2-fold increase in the rate of vaginal delivery of a cephalic infant.¹⁵ Alternatively, Sullivan *et al.* recently demonstrated no difference in the success rate of ECV or in the rate of subsequent vaginal delivery comparing CSE anesthesia to systemic opioid anesthesia; however, this study was underpowered to detect the difference in ECV success that was actually observed in the study.¹¹ Pooling the six RCTs enabled us to overcome the sample size limitations of prior studies. These pooled risk estimates are reassuring given the absence of statistical heterogeneity between studies. Additionally, we found no evidence of publication bias.

Although the ultimate goal of ECV is to avoid cesarean delivery, the 11% reduction of cesarean delivery rates (from 59.3% to 48.4%) with the use of regional anesthesia in this meta-analysis was not statistically significant. This is likely because multiple factors other than cephalic presentation are required to achieve a successful vaginal delivery, and the decision to proceed with cesarean delivery can often be highly provider-dependent. This is reflected by the high degree of heterogeneity observed between studies evaluating this outcome. While we used a random-effects model to account for this heterogeneity and obtain more conservative risk estimates, it was not possible to account for all of the underlying factors driving cesarean delivery rates in the different studies. Additionally, several subjects in these studies were delivered vaginally despite breech presentation, likely by providers experienced in vaginal breech delivery. Finally, despite pooling five studies, our inability to demonstrate a statistically significant difference in cesarean delivery rates may be due to a limitation in the sample size of the pooled studies. A sample size calculation demonstrated that 850 patients per arm would be necessary to detect a clinically significant risk reduction of 20% in cesarean delivery rate.

Because regional anesthesia is postulated to work in part by relaxation of the abdominal wall, some may question whether or not regional anesthesia is still beneficial when tocolytics are used for ECV. All six RCTs used a protocol where each subject received a tocolytic (terbutaline, ritodrine or nifedipine), demonstrating that regional anesthesia remains beneficial even when tocolytic agents are given prior to the ECV.

Since the majority of studies reported results for multiparous and primiparous patients combined, we are unable to comment on the efficacy of regional anesthesia in each population. Two of the studies included in our analysis did evaluate multiparous and nulliparous patients individually, both demonstrating an increased rate of ECV success with the use of regional anesthesia.^{10,12}

Baseline rates of ECV success in the patients who did not receive regional anesthesia varied between 31.2-57.5% in the individual studies, with only one study's baseline success rate approaching the average success rate of 58% frequently quoted in the literature.^{1,12} In addition to maternal and fetal characteristics, it is likely that provider experience contributes to the wide variation of this estimate. All studies included in the analysis were performed at university hospitals under the supervision of experienced attending physicians. The technique of ECV varied between studies and was often left to the discretion of the provider. While the variation in experience and technique both within and between studies introduces clinical heterogeneity, this also may increase the generalizability of our results to clinical practice. Finally, when the baseline ECV success rate was varied in our analysis, we continued to observe a highly favorable number needed to treat.

In conclusion, results from this systematic review and meta-analysis demonstrate that use of regional anesthesia is associated with an increase in the rate of ECV success, with a highly favorable number needed to treat of five. Additionally, adverse outcomes associated with ECV were rare and not significantly different in the two groups. Despite the significant increase in ECV success with regional anesthesia, the reduction in cesarean delivery rate was relatively small and not statistically significant. Future well-powered studies designed specifically to investigate the effect of regional anesthesia use during ECV on subsequent cesarean delivery rates are warranted.

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Figure 1.
Flow diagram of studies included in meta-analysis.

Figure 2. Forest plot of the outcome of successful external cephalic version comparing regional anesthesia to intravenous or no anesthesia. Pooled risk ratio is 1.58 (95% CI 1.29-1.93), $I^2=14.9\%$.

Figure 3.

Begg funnel plot of the primary outcome of successful external cephalic version comparing regional to intravenous or no anesthesia. This is a plot of the logarithm of the risk ratio ($\log_RR$) against the standard errors of the $\log_RR$ s with pseudo 95% confidence intervals. Visual inspection suggests the absence of publication bias.

Figure 4. Forest plot of the outcome of cesarean delivery comparing regional anesthesia to intravenous or no anesthesia. Pooled risk ratio is 0.80 (95% CI 0.55-1.17), $I^2=76.5\%$.

Characteristics of Studies Included in Meta-Analysis Comparing the Effect of Regional Anesthesia to No Regional Anesthesia on the Success Rate of ECV

Table 1

Study	Design	Population			Inclusion Criteria	Exclusion Criteria
		Total	Regional Anesthesia	No Anesthesia		
Weiniger et al. (2010)	RCT	64	31	33	ASA status I-II, 37-40 weeks gestation, no fetal abnormality (including growth restriction), no contraindication for vaginal delivery, no contraindication for regional anesthesia, multiparity	Previous cesarean section, previous myomectomy with uterine cavity penetration or uterine anomaly, morbid obesity (BMI>40 kg/m ²), AFI<7 cm, neuropathy, severe back pain with radiculopathy, patient refusal of regional anesthesia, poor communication, request for elective Cesarean section
Sullivan et al. (2009)	RCT	95	47	48	≥36 weeks' gestation, willing to receive either CSE analgesia or systemic opioid analgesia	Contraindications for neuraxial anesthesia, allergy to any study medication
Weiniger et al. (2007)	RCT	70	36	34	ASA status I-II, 37-40 weeks' gestation, no fetal abnormality, nulliparity	Previous uterine surgery, uterine anomaly, contraindication to vaginal delivery, contraindication to regional analgesia, patient refusal of regional analgesia, neuropathy, severe back pain with radiculopathy, poor communication, morbid obesity (BMI >40 kg/m ²)
Mancuso et al. (2000)	RCT	108	54	54	18 years of age, 37 weeks' gestation, intact membranes, EFW between 2000-4000 grams, reassuring fetal heart rate testing	Placenta previa, prior classical Cesarean delivery, third-trimester bleeding, AFI<5 cm or >25 cm, known uterine malformation, uncontrolled hypertension, suspected major fetal anomaly, active-phase labor
Dugoff et al. (1999)	RCT	102	50	52	≥36 weeks' gestation, reactive non-stress test, intact membranes with a minimum 2 × 2 cm pocket of amniotic fluid	Gross fetal anomalies, uterine malformation, macrosomia (EFW>4000 grams), fetal growth restriction, placenta previa, third-trimester vaginal bleeding, labor, contraindications to spinal anesthesia or terbutaline
Schorr et al. (1997)	RCT	69	35	34	>37 weeks' gestation	Placenta previa, evidence of fetal compromise, intrauterine growth restriction, rupture of membranes

ECV=external cephalic version; RCT=randomized controlled trial; ASA=American Society of Anesthesiologists; BMI=body mass index; AFI=amniotic fluid index; CSE=combined spinal-epidural; EFW=estimated fetal weight

Table 2
Qualitative Data From Studies Comparing Success Rates of ECV in Patients With and Without Regional Anesthesia

	Weiniger et al. (2010)	Sullivan et al. (2009)	Weiniger et al. (2007)	Mancuso et al. (2000)	Dugoff et al. (1999)	Schorr et al. (1997)
Random allocation	Yes	Yes	Yes	Yes	Yes	Yes
Concealed allocation	Yes	Yes	Yes	Yes	Yes	Yes
Intent-to-Treat Analysis	Yes	----	Yes	----	Yes	----
Median GA in Regional Anesthesia Group (wks)	38.1	37.0	37.9	38.1	38.0	38.0
Median GA in Control Group (wks)	38.2	37.0	37.9	37.9	38.0	37.4
Type of Regional Anesthesia	Spinal	CSE	Spinal	Epidural	Spinal	Epidural
Anesthesia Used in Control Group	None	IV Fentanyl	None	----	----	----
Nulliparous Patients Included	No	Yes	Yes	Yes	Yes	Yes
Multiparous Patients Included	Yes	Yes	No	Yes	Yes	Yes
Trial Setting	Single center, university	Single center, university	Single center, university	Single center, university	Single center, university	Single center, university
Tocolytics Used	Yes	Yes	Yes	Yes	Yes	Yes
Type of Tocolytic	Ritodrine/ Nifedipine*	Terbutaline	Ritodrine/ Nifedipine*	Terbutaline	Terbutaline	Terbutaline
Maternal Discomfort Recorded	Yes	Yes	Yes	No	Yes	Yes
Measurement of Maternal Discomfort	VAS	VAS	VAS	----	Request to stop version	Request to stop version

ECV=external cephalic version; GA=gestational age; CSE=combined spinal-epidural; IV=intravenous; VAS=visual analogue scale

----, data not reported

* Ritodrine became unavailable after April 2003 and was replaced by sublingual Nifedipine in the study protocol

Table 3

Quantitative Data on ECV Success Rates, Cesarean Delivery Rates, and Adverse Outcomes Comparing Patients With and Without Regional Anesthesia

Study	Successful Version		Cesarean Delivery		Emergent Cesarean		Abruption		Transient Bradycardia		Terminal Bradycardia	
	RA	No RA	RA	No RA	RA	No RA	RA	No RA	RA	No RA	RA	No RA
Weiniger et al. (2010)	27/31	19/33	4/31	3/33	0/31	0/33	0/31	0/33	3/31	1/33	0/31	0/33
Sullivan et al. (2009)	22/47	15/48	30/47	36/48	1/47	1/48	0/47	0/48	7/47	5/48	1/47	1/48
Weiniger et al. (2007)	24/36	11/34	----	----	0/36	0/34	0/36	0/34	----	----	0/36	0/34
Manuso et al. (2000)	32/54	18/54	25/54	38/54	0/54	0/54	0/54	0/54	2/54	3/54	0/54	0/54
Dugoff et al. (1999)	22/50	22/52	34/50	27/52	0/50	0/52	0/50	1/52	11/50	6/52	0/50	0/52
Schorr et al. (1997)	24/35	11/34	12/35	27/34	----	----	----	----	----	----	----	----

ECV=external cephalic version; RA=regional anesthesia

Data are n/N

----, data not reported