JOURNAL of ANESTHESIA and PERIOPERATIVE MEDICINE

Systematic Review and Meta-Analysis

General versus Neuraxial Anesthesia in Cesarean Section: A Systematic Review

Lei Yang[1*], Xu Cheng[1*], Di Yang[2] and Ru-Rong Wang[1]

ABSTRACT

Background: Neuraxial anesthesia is preferred anesthesia technique for cesarean section. But recently the safety of general anesthesia improved well. So it is important to clarify the safety of general anesthesia and neuraxial anesthesia for cesarean section.

Methods: We searched CENTRAL/Ovid (September, 2016), EMBASE/Ovid (1974 to October 12, 2016), MEDLINE/Ovid (1946 to October 12, 2016). We only included randomized controlled trials (RCTs) which compared general anesthesia versus neuraxial anesthesia including spinal anesthesia, epidural anesthesia or combined spinal and epidural anesthesia in cesarean section. Two authors independently assessed the studies for inclusion, extracted the data and performed the analysis.

Results: A total of 1394 mothers were involved in the 15 included studies. For neonatal outcomes, at 1 minute after delivery, Apgar score was significantly lower in maternal general anesthesia group (mean difference[MD] -0.71, 95% confidence intervals [CI] -0.99 to -0.43) and the risk of newborns for Apgar score lower than 7 was higher when the mother underwent general anesthesia (risk ratio [RR] 4.81, 95% CI 1.72 to 13.46). At 5 minutes after delivery, Apgar score was still lower in maternal general anesthesia group (MD -0.31, 95% CI -0.59 to -0.02), but the risk of newborns for Apgar score lower than 7 showed no difference in statistical analysis under general or neuraxial anesthesia (RR 2.31, 95% CI 0.08 to 64.48). Besides, no neonatal deaths were reported, and risk of oxygen by mask or intubation (RR 1.23, 95% CI 0.33 to 4.53) also showed no difference in statistical analysis in both groups. For maternal outcomes, there were more blood loss in general anesthesia group (MD 75.8, 95% CI 21.18 to 130.41), but the risk of receiving postoperative blood transfusion was similar in both groups (RR 2.85, 95% CI 0.93 to 8.72). Besides, the risk of shivering (RR 8.00, 95% CI 1.14 to 56.33), nausea (RR 1.47, 95% CI 0.99 to 2.17) and vomiting (RR 4.13, 95% CI 1.41 to 12.09) was higher in general anesthesia group. But the risk of headache (RR 0.11, 95% CI 0.01 to 0.87) and pruritus (RR 0.13, 95% CI 0.02 to 0.99) was higher in neuraxial anesthesia group.

Conclusions: For clinical practice, we recommended neuraxial anesthesia as first choice in cesarean section. For further clinical researches, more non-surrogate outcomes should be reported, such as maternal and neonatal mortality and morbidity. (Funded by the National Natural Science Foundation of China, and the Science & Technology Department of Sichuan Province, China.)

From [1]Department of Anesthesiology, West China Hospital, Sichuan University, Chengdu, China; [2]Department of Anesthesiology, Sichuan Provincial People's Hospital, Chengdu, China.

[*]Lei Yang and Xu Cheng contributed equally to this work.

Correspondence to Dr. Ru-Rong Wang at 576950028@qq.com.

Citation: Lei Yang, Xu Cheng, Di Yang, Ru-Rong Wang. General versus neuraxial anesthesia in cesarean section: a systematic review. *J Anesth Perioper Med* 2017; 4: 114-22. doi:10.24015/JAPM.2017.0028

Cesarean section is a procedure of baby delivery through an incision of abdominal and uterus wall of mothers. It is an alternative way if vaginal delivery is possible to cause harm to mothers or babies.

Both of neuraxial and general anesthesia techniques are considered in cesarean section. Neuraxial anesthesia technique included spinal, epidural or combined spinal and epidural anesthesia. Due to the minimal anesthetic exposure to babies and possible risk of general anesthesia such as difficult airway, neuraxial techniques are preferred anesthesia methods for cesarean section (1). However, general anesthesia is a faster technique than neuraxial anesthesia. So it would be a prior anesthesia technique in some emergent situation. Besides, neuraxial anesthesia was contraindicated in some situation, such as coagulation disorders. Therefore, general anesthesia was still an important technique in cesarean section.

As more comprehensive understanding of pregnant physiology and more use of short-acting anesthetic agents in recent years, the safety of general anesthesia improved well (2). It is important to clarify the safety of general anesthesia and neuraxial anesthesia for cesarean section.

METHODS

Eligibility Criteria

Types of Studies

Only randomized controlled trials (RCTs) which compared general anesthesia with neuraxial anesthesia including spinal anesthesia, epidural anesthesia or combined spinal and epidural anesthesia in cesarean section were included. We restricted the included articles in English or Chinese.

Types of Participants

Mothers with or without any complication underwent cesarean section were included.

Types of Interventions

General anesthesia constituted to intervention group. Neuraxial anesthesia including spinal, epidural or combined spinal and epidural anesthesia constituted to control group. We compared the intervention group versus control group.

Types of Outcome Measures

Primary outcomes included neonatal mortality, risk of neonatal Apgar score < 7 at 1 and 5 minutes after delivery. Secondary outcomes included mean neonatal Apgar scores at 1 and 5 minutes after delivery, need for oxygen by mask or intubation in newborns, risk for receiving postoperative blood transfusion in mothers, mean maternal blood loss, maternal adverse events such as risk of postoperative nausea and vomiting, headache, pruritus and shivering.

Electronic Search

The following databases were searched (for detail search strategy see Appendix): CENTRAL/Ovid (September, 2016), EMBASE/Ovid (1974 to October 12, 2016), MEDLINE/Ovid (1946 to October 12, 2016). Search Strategy are as follows: 1). (spinal or epidural or reginal).mp; 2). general.mp; 3). (anesthesia or anaesthesia).mp; 4). 1 and 2 and 3; 5). (caesarean section or cesarean section).mp; 6). (randomized-controlled-trial/ or randomization/ or controlled-study/or multicenter-study/ or phase-3-clinical-trial/or phase-4- clinical- trial/ or double- blind- procedure/ or single- blind- procedure/ or (random* or cross?over* or multicenter* or factorial* or placebo* or volunteer*).mp. or ((singl* or doubl* or trebl* or tripl*) adj3 (blind* or mask*)).ti,ab. or (latin adj square).mp.) not (animals not (humans and animals)).sh; 7). 4 and 5 and 6.

Study Selection

Two authors independently screened all records for eligibility based on their titles, abstracts and keywords. We retrieved the full published version of the selected studies for further assessment. Only those studies completely met the inclusion criteria were included. We resolved any disagreements by discussing and consulting with a third author.

Data Collection

Two authors independently extracted data from included studies. The extracted information included age, complications, anesthesia drugs, primary and secondary outcomes. We resolved any disagreement by discussion.

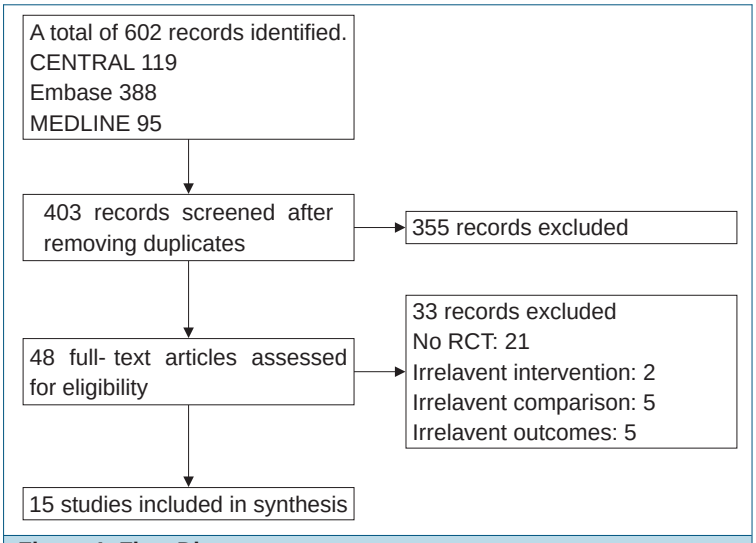

Figure 1. Flow Diagram.

Risk of Bias in Included Studies

We performed risk of bias assessment by using 'Risk of bias' tool described in Chapter 8 of the Cochrane Handbook for Systematic Reviews of Interventions 3. We assessed the 7 domains as follows for each study: random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting and any other potential bias. The judgment for each domain was low risk, high risk or unclear.

We considered a trial as having low risk of bias if all domains were assessed as low risk. We considered a trial as having high risk of bias if one or more domains were assessed as high or unclear risk.

Summary Measures

We calculated the risk ratio (RR) with 95% confidence intervals (CIs) for the dichotomous data. We also used the mean difference (MD) with 95% CIs for continuous data if same scales were used in all studies.

Synthesis of Results

We performed all analysis by using Review Manager 5.3. We used random- effect model as the heterogeneity exist between trials.

We estimated mean and SD from the median and range as described by Hozo (4). We assessed the statistical heterogeneity according to both Chi^2 test and I^2 statistic. For the Chi^2 test, we considered the statistical significance with P value <0.1. I^2 statistic indicated the percentage of heterogeneity impact on the meta- analysis. We considered heterogeneity to be substantial if the $I^2 > 50\%$.

Sensitive Analysis

We performed sensitive analysis as excluding the studies with high risk of bias to determine the effect of methodological quality on the results.

RESULTS

Study Selection

We found 602 records according to our search strategy. A total of 403 records remained after removing duplicates. We screened all the titles, abstracts and keywords for eligibility. Forty-eight full texts were retrieved for further assessment. Finally,15 studies (5-19) were included in synthesis (Figure 1).

Studies Characteristics

Included studies characteristics were shown in Table.

Risk of Bias in Included Studies

Risk of bias summary and graph were shown in Figure 2 and Figure 3. Only 3 studies were judged as low risk of bias (10, 15, 18). Selection bias and attrition bias were the main problems in methodology.

Sequence Generation (Selection Bias)

We judged this item as low risk of bias in 7 studies, five of which used computer-generated random number table (5- 7, 10, 13) and two of which generated sequence by drawing lots (15, 18). We judged this item as unclear risk of bias in the rest eight included studies, because they did not describe detailed randomized method (8, 9, 11, 12, 14, 16, 17, 19).

Allocation Concealment (Selection Bias)

We judged this item as low risk of bias in 4 studies, two of which concealed allocation in sealed envelopes (7, 10) and two of which by drawing lots (15, 18). We judged this item as high risk of

Table. Characteristics of Included Studies.

	Sample size	Maternal complications	General anesthetics used before delivery	General anesthetics used after delivery	Regional anesthetics	Neuraxial anesthesia technique	Outcomes
Aksoy 2015	418	no	5-7 mg/kg Thio 1 mg/kg Suc 1.5% Sevo	2 μg/kg Fen 0.03 mg/kg Mida 0.15 mg/kg Roc 1% Sevo+50% N_2O	0.5% Bupi 8-10 mg 20 μg Fen	SA	5
Bakri 2015	40	Maternal sickle cell anemia	2-2.5 mg/kg Prop 0.5 mg/kg Atr 1-2% Iso	1 μg/kg Fen (0.5 μg/kg Fen and 0.1 mg/kg Atr as needed)	0.5% Bupi 8-12 mg 10 μg Fen	SA	1, 3, 5, 6, 7
Dermitzaki 2009	35	no	4 mg/kg Thio 1-1.5 mg/kg Suc 1% Sevo+50% N_2O (0.1 mg/kg Vec as needed)	4 μg/kg Fen 2 mg Mida	0.5% Bupi 1.8-2.2 ml (1 μg/kg Fen in epidural space)	CSEA	3
Honca 2014	40	no	4 mg/kg Thio 0.6-0.8 mg/kg Roc 1% Sevo+50% N_2O	1 μg/kg Fen	0.5% Bupi 2.5 ml 10 μg Fen	SA	3
Hong J-Y 2003	25	Maternal placenta previa	4-5 mg/kg Thio 1 mg/kg Suc (Vec as needed)1% Enf+50% N_2O	0.5% Enf+50% N_2O 3 mg Mida 30 mg pentazocine	2% Lido 20 ml	EA	3, 5, 6, 7
Jain 2013	40	growth-restricted foetuses	5 mg/kg Thio 1.5 mg/kg Suc 0.5-1% Iso+50% N_2O 0.05 mg/kg Atr	0.05 mg/kg Mor	0.5% Bupi 1.6 ml 20 μg Fen	SA	2, 3, 4, 7
Kavak 2001	104	no	5 mg/kg Thio 1.5 mg/kg Suc 1MAC Sevo+50% N_2O 0.1 mg/kg Vec	-	0.5% Bupi 12.5 mg 200 μg Mor	SA	3, 4
Kinzhalova 2012	40	Chronic arterial hypertension	Thio 2% Sevo+50% N_2O	-	12.5 mg Bupi	SA	3
Mancuso 2010	179	no	2-2.5 mg/kg Prop 0.08-0.1 mg/kg Cis 0.5 MAC Sevo+50% N_2O	-	10-12.5 mg Bupi	SA	2, 3, 7
Saracoglu 2012	61	no	5 mg/kg Thio 0.5 mg/kg Atr 1% Sevo+50% N_2O	2 μg/kg Fen 1.5% Sevo+50% N_2O	0.5% Bupi 1.8 ml 20 μg Fen	SA	7
Saygi 2015	100	no	4-5 mg/kg Thio 0.8 mg/kg Roc 1-1.5% Sevo+50% N_2O	-	0.5% Bupi 2.2 ml	SA	2, 3
Sener 2003	30	no	4 mg/kg Thio 1.5 mg/kg Suc 0.5% Iso+50% N_2O	1% Iso+66% N_2O (Vec as needed)	0.375% Bupi 20 ml	EA	3, 7
Sivevski 2015	60	preeclampsia	2-2.5 mg/kg Prop 1.5 mg/kg Suc	0.75- 1.5% Iso + 50% N_2O 0.6 mg/kg Roc	0.5% Bupi 6-8mg 20 μg Fen	SA	2
Solangi 2012	160	no	2 mg/kg Prop 1.5 mg/kg Suc 0.5 mg/kg Atr 0.25-0.5% Iso+N_2O	0.2 mg/kg Nalbuphine	0.75% Bupi 1.5 ml	SA	2, 3

Table. Characteristics of Included Studies (Continued).

	Sample size	Maternal complications	General anesthetics used before delivery	General anesthetics used after delivery	Regional anesthetics	Neuraxial anesthesia technique	Outcomes
Yegn 2003	62	no	5 mg/kg Thio 0.02 mg/kg Vec 1.5 mg/kg Suc 0.3% Iso	0.5- 0.6% Iso + 66% N_2O (Fen and Vec as need)	0.5% Bupi 15 ml	EA	3

Atr, atracurium; Bupi, bupivacaine; Cis, cis-atracurium; Enf, enflurane; Fen, fentanyl; Iso, isoflurane; Lido, lidocaine; Mida, midazolam; Mor, morphine; Prop, propofol; Roc, rocuronium; Sevo, sevoflurane; Suc, succinylcholine or suxamethonium; Thio, thiopental; Vec,vecuronium; Outcomes: 1, neonatal mortality; 2, risk of Apgar score < 7 at 1 and 5 minutes after delivery; 3, mean neonatal Apgar scores at 1 and 5 minutes after delivery; 4, risk for oxygen by mask or intubation in newborns; 5, risk for receiving postoperative blood transfusion in mothers; 6, mean maternal blood loss; 7, risk of maternal adverse events.

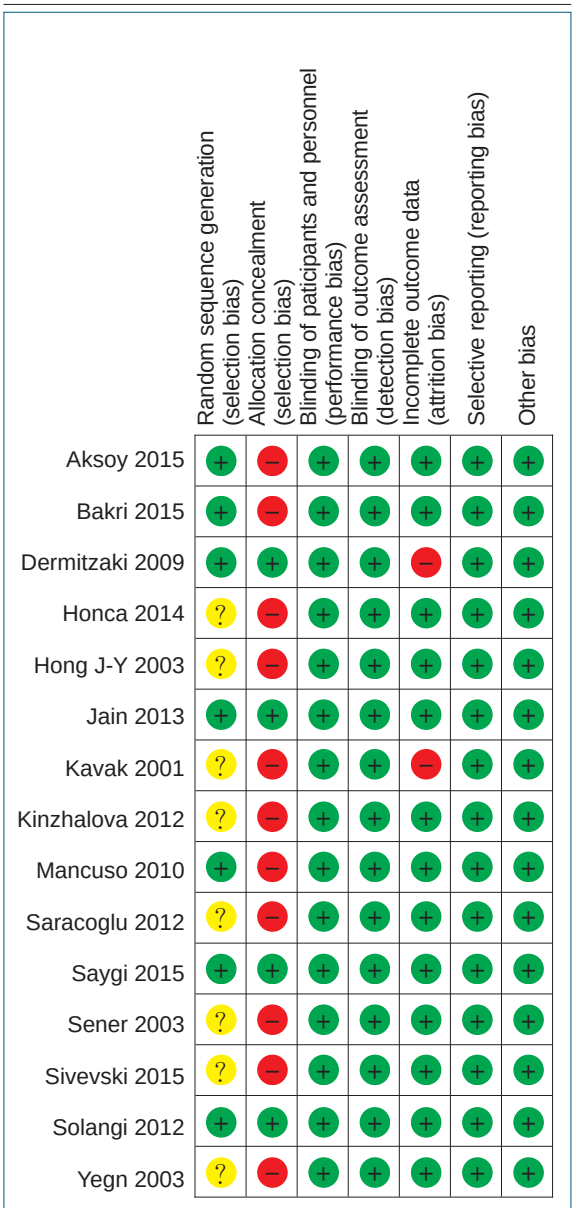

Figure 2. Risk of Bias Summary.

bias in the rest 11 included studies, because no studies presented any information about allocation concealment.

Blinding (Performance Bias and Detection Bias)

No studies mentioned blind they used, but the primary outcomes were not influenced by blind method. So we judged low risk of bias for all included studies.

Incomplete Outcome Data (Attrition Bias)

Missing data occupied more than 15% in 2 studies (7, 11). As the primary outcomes were low incidence events, so we judged 2 studies as high risk of bias. The other included studies were judged as low risk of bias.

Selective Reporting (Reporting Bias) and Other Potential Sources of Bias

None selective reporting or other potential bias were detected in all included studies.

Synthesis of Results

Neonatal Mortality

Only one study (6) reported neonatal mortality. It reported that no neonatal death occurred in general anesthesia or neuraxial anesthesia group.

Risk of neonatal Apgar score <7 at 1 and 5 minutes after delivery

Five studies (10, 13, 15, 17, 18) reported risk of Apgar score <7 at 1 minute after delivery. It indicated that newborns had higher risk of lower than 7 Apgar score at 1 minute after delivery in maternal general anesthesia group (RR 4.81, 95% CI 1.72 to 13.46) (Figure 4). But two studies (17, 18) reported that the risk of Apgar

score <7 at 5 minute after delivery was similar in maternal general and neuraxial anesthesia group (RR 2.31, 95% CI 0.08 to 64.48) (Figure 5).

Mean Neonatal Apgar Scores at 1 and 5 Minutes after Delivery

Eleven studies (6- 12, 15, 16, 18, 19) and 12 studies (6- 13, 15, 16, 18, 19) reported mean neonatal Apgar score at 1 and 5 minutes after delivery, respectively. The result showed that neonatal Apgar scores was significantly lower in maternal general anesthesia group than neuraxial anesthesia group at 1 minute (MD -0.71, 95% CI - 0.99 to - 0.43) (Figure 6) and 5 minutes (MD - 0.31, 95% CI - 0.59 to - 0.02) after delivery (Figure 7).

Risk for Oxygen by Mask or Intubation in Newborns

Two studies (10, 11) reported risk of oxygen by mask or intubation in newborns. The result indicated that no significant difference between maternal general anesthesia group and neuraxial anesthesia group (RR 1.23, 95% CI 0.33 to 4.53).

Mean Maternal Blood Loss

Two studies (6, 9) reported maternal blood loss. It indicated that there were more blood loss in maternal general anesthesia group than neuraxial anesthesia group (MD 75.8, 95% CI 21.18 to 130.41).

Risk for Receiving Postoperative Blood Transfusion in Mothers

Three studies (5, 6, 9) reported the risk for receiving postoperative blood transfusion in mothers. The result showed that there was no significant difference between maternal general anesthesia group and neuraxial anesthesia group (RR 2.85, 95% CI 0.93 to 8.72).

Risk of Maternal Ddverse Events

Five studies (6, 9, 10, 14, 16) reported risk of postoperative nausea, with no significant difference between maternal general anesthesia group and neuraxial anesthesia group (RR 1.47, 95% CI 0.99 to 2.17). Four studies (6, 10, 14, 16) reported risk of postoperative vomiting. The result demonstrated that there was significantly higher risk in maternal general anesthesia group

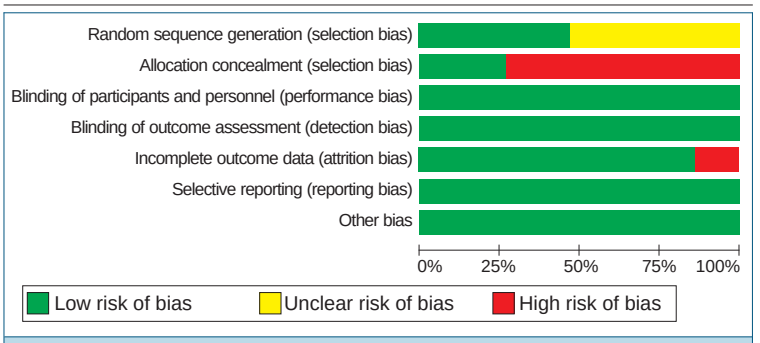

Figure 3. Risk of Bias Graph.

than neuraxial anesthesia group (RR 4.13, 95% CI 1.41 to 12.09). One study (16) reported risk of shivering, and there was significantly higher risk in maternal general anesthesia group than neuraxial anesthesia group (RR 8.00, 95% CI 1.14 to 56.33). Two studies (6, 13) reported risk of headache. The result indicated that there was significantly lower risk in maternal general anesthesia group than neuraxial anesthesia group (RR 0.11, 95% CI 0.01 to 0.87). Two studies (9, 14) reported risk of pruritus, with significantly lower risk in maternal general anesthesia group than neuraxial anesthesia group (RR 0.13, 95% CI 0.02 to 0.99).

Sensitive Analysis and Subgroup Analysis

We performed sensitive analysis as excluding studies with high risk of bias. Therefore, only three studies (10, 15, 18) were included. The result of mean neonatal Apgar score at 5 minutes after delivery was changed (MD -0.26, 95% CI -0.80 to 0.28). The rest results as mean neonatal Apgar score at 1 minutes after delivery, risk of neonatal Apgar score < 7 at 1 and 5 minutes after delivery, risk for oxygen by mask or intubation in newborns and risk of postoperative nausea was not changed.

Heterogeinity was still significant when we performed subgroup analysis according to different neuraxial anesthesia technique, with or without maternal complications or whether using muscle relaxant before delivery or not.

DISCUSSION

Summary of Evidence

A total of 1394 mothers were involved in the 15

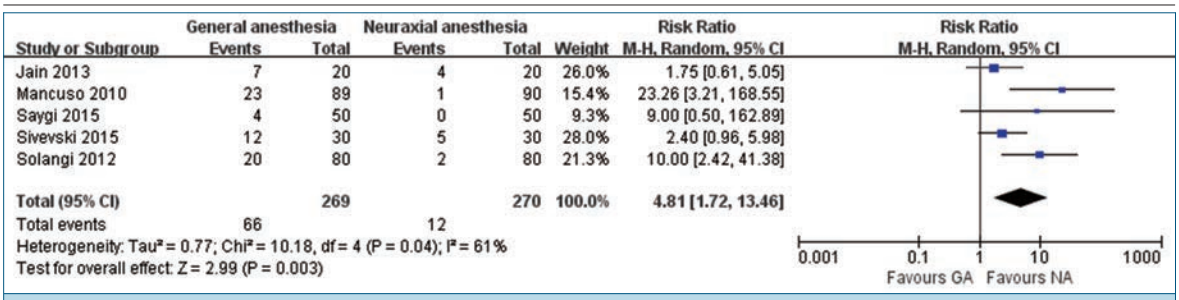

Figure 4. Risk of Neonatal Apgar Score < 7 at 1 Minute after Delivery.

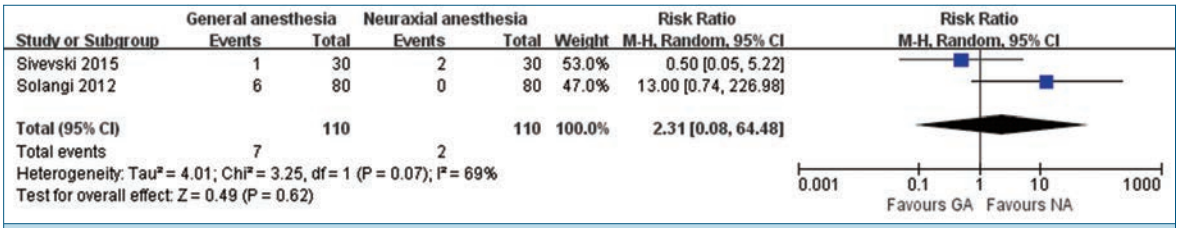

Figure 5. Risk of Neonatal Apgar Score < 7 at 5 Minutes after Delivery.

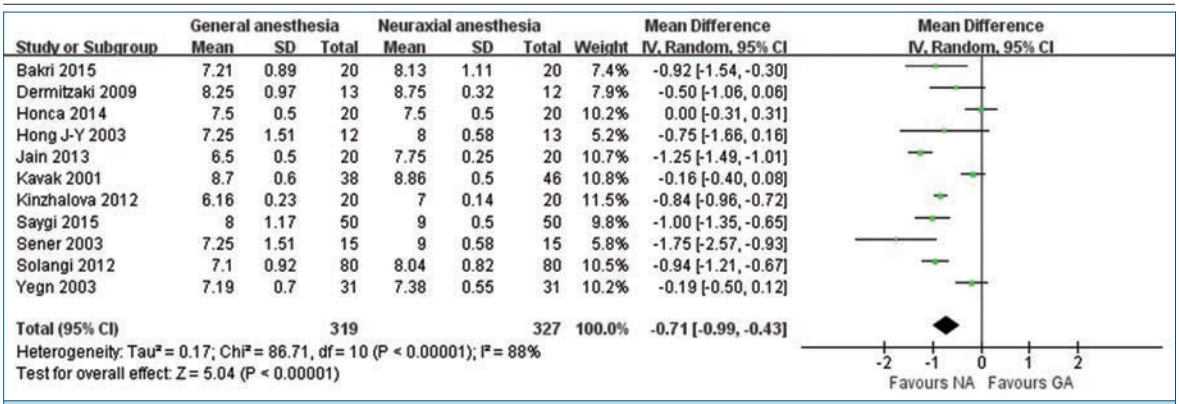

Figure 6. Mean Neonatal Apgar Scores at 1 Minute after Delivery.

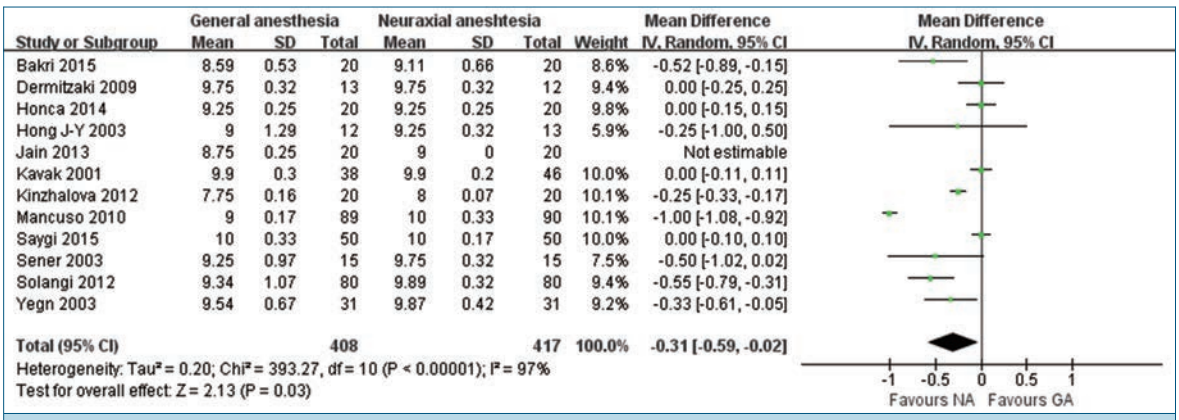

Figure 7. Mean Neonatal Apgar Scores at 5 Minutes after Delivery.

included studies. In these included studies, 11 of them (5, 6, 8, 10-15, 17, 18) with 1242 mothers compared general anesthesia to spinal anesthesia, 3 of them (9, 16, 19) with 117 mothers compared general anesthesia to epidural anesthesia and 1 of them with 35 mothers compared gener-

al anesthesia to combined spinal and epidural anesthesia.

For neonatal outcomes, at 1 minute after delivery, we found Apgar score was significantly lower in maternal general anesthesia group. Meanwhile, the risk of newborns for Apgar score lower than 7 was higher when mother underwent general anesthesia. These results suggested that anesthesia technique would affect the newborn's immediate condition after delivery. The risk of hypoxia may be higher in maternal general anesthesia group. But for the later condition, at 5 minutes after delivery, the risk of newborns for Apgar score lower than 7 was similar under general or neuraxial anesthesia. For the non- surrogate outcomes, such as neonatal mortality and risk of oxygen by mask or intubation, the results were similar in different anesthesia technique. The findings indicated that general anesthesia was a safe alternative technique for newborns, but the risk of early hypoxia should be paid attention.

For maternal outcomes, the mean blood loss was more in general anesthesia group, but the risk for receiving postoperative blood transfusion in mothers was similar in general and neuraxial anesthesia groups. It indicated that general anesthesia was possibly related to more maternal bleeding during cesarean section, although the 2 included studies had high risk of selection bias. Besides, the risk of shivering, nausea and vomiting was higher in general anesthesia group. But the risk of headache and pruritus was higher in neuraxial anesthesia group. Recently, The U.S. Food and Drug Administration (FDA) released a warning of general anesthetics on pregnant woman (20). It warned that more than 3 hours use of general anesthetics in pregnant woman during their third trimester may affect the neuron development in newborn babies. So even the above adverse events we listed were not fatal, we should also concerned seriously the necessity of general anesthesia in cesarean section. Practically, the majority of cesarean section was no more than 3 hours. Therefore, if there were some contraindications of neuraxial anesthesia for mothers, such as bleeding tendency, or emergent condition, general anesthesia should be considered as an alternative anesthesia technique.

Due to including articles published in recent 5 years, we found mean Apgar score was lower at 1 and 5 minutes after delivery in maternal general anesthesia group, which was different from other systematic review before (21). Thus, even there was no death or other severe complications found in maternal general anesthesia group, we still recommended neuraxial anesthesia as first choice in cesarean section. In fact, it was consistent with our clinical practice. A clinical practice survey in Europe, spinal anesthesia was the most favored technique among anesthesiologists, and general anesthesia was an alternative technique in some particular mothers (22).

Limitations

Firstly, according to the methodological assessment, only three of included studies were considered as low risk of bias. Although the three studies included 300 mothers and the results was not changed in sensitive analysis, we also considered well- designed large sample sized RCTs were needed. What's more, the restriction of language could either miss some potential useful data.

CONCLUSIONS

For clinical practice, we recommended neuraxial anesthesia as first choice in cesarean section, because more adverse effect were reported both in newborns and mothers under general anesthesia.

For further clinical research, more non-surrogate outcomes should be reported, such as maternal and neonatal mortality and morbidity.

This study was funded by the National Natural Science Foundation of China (No. 81170077) and Science & Technology Department of Sichuan Province (No. 2017SZ0147).
The authors declare no other potential conflicts of interest for this work.

References

1. Rollins M, Lucero J. Overview of anesthetic considerations for Cesarean delivery. *Br Med Bull* 2012;101:105-25.
2. Sumikura H, Niwa H, Sato M, Nakamoto T, Asai T, Hagihira S. Rethinking general anesthesia for cesarean section. *J Anesth* 2016;30:268-73.
3. Higgins JPT, Green S. Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011] . *The Cochrane Collaboration*;2011.
4. Hozo SP, Djulbegovic B, Hozo I. Estimating the mean and variance from the median, range, and the size of a sample. *BMC Med Res Methodol* 2005;5:13.
5. Aksoy H, Aksoy Ü, Yücel B, Özyurt SS, Açmaz G, Babayiğit MA, et al. Blood loss in elective cesarean section: Is there a difference related to the type of anesthesia? A randomized prospective study. *J Turk Ger Gynecol Assoc* 2015;16:158-63.
6. Bakri MH, Ismail EA, Ghanem G, Shokry M. Spinal versus general anesthesia for cesarean section in patients with sickle cell anemia. *Korean J Anesthesiol* 2015;68:469-75.
7. Dermitzaki E, Staikou C, Petropoulos G, Rizos D, Siafaka I, Fassoulaki A. A randomized study of maternal serum cytokine levels following cesarean section under general or neuraxial anesthesia. *Int J Obstet Anesth* 2009;18:33-7.
8. Honca M, Purtuloglu T, Akgul EO, Oztosun M, Honca T, Sizlan A, et al. Effects of general and spinal anesthetic techniques on endothelial adhesion molecules in cesarean section. *Korean J Anesthesiol* 2014;66:364-70.
9. Hong JY, Jee YS, Yoon HJ, Kim SM. Comparison of general and epidural anesthesia in elective cesarean section for placenta previa totalis: maternal hemodynamics, blood loss and neonatal outcome. *Int J Obstet Anesth* 2003;12:12-6.
10. Jain K, Bhardwaj N, Sharma A, Kaur J, Kumar P. A randomised comparison of the effects of low-dose spinal or general anaesthesia on umbilical cord blood gases during caesarean delivery of growth-restricted foetuses with impaired Doppler flow. *Eur J Anaesthesiol* 2013;30:9-15.
11. Kavak ZN, Başgül A, Ceyhan N. Short-term outcome of newborn infants: spinal versus general anesthesia for elective cesarean section. A prospective randomized study. *Eur J Obstet Gynecol Reprod Biol* 2001;100:50-4.
12. Kinzhalova S, Davidova N, Makarov R. Neonatal outcome in women with arterial hypertension following Cesarean section under general and spinal anaesthesia. *Eur J Anaesthesiol* 2012;29:167.
13. Mancuso A, De Vivo A, Giacobbe A, Priola V, Maggio Savasta L, et al. General versus spinal anaesthesia for elective caesarean sections: effects on neonatal short-term outcome. A prospective randomised study. *J Matern Fetal Neonatal Med* 2010;23:1114-8.
14. Saracoglu KT, Saracoglu A, Umuroglu T, Eti Z. Neuraxial block versus general anaesthesia for cesarean section: post-operative pain scores and analgesic requirements. *J Pak Med Assoc* 2012;62:441-4.
15. Saygi AI, Ozdamar O, Gun I, Emirkadi H, Mungen E, Akpak YK. Comparison of maternal and fetal outcomes among patients undergoing cesarean section under general and spinal anesthesia: a randomized clinical trial. *Sao Paulo Med J* 2015;133:227-34.
16. Sener EB, Guldogus F, Karakaya D, Baris S, Kocamanoglu S, Tur A. Comparison of neonatal effects of epidural and general anesthesia for cesarean section. *Gynecol Obstet Invest* 2003;55:41-5.
17. Sivevski AG, Sholjakova MV, Kartalov AB, Kuzmanovska BK, Durnev VM. Comparison of low dose spinal anesthesia with general anesthesia in preeclamptic parturients undergoing emergency cesarean section. *Anaesthesia, Pain and Intensive Care* 2015;19:37-43.
18. Solangi SA, Siddiqui SM, Khaskheli MS, Siddiqui MA. Comparison of the effects of general vs spinal anesthesia on neonatal outcome. *Anaesthesia, Pain and Intensive Care* 2012;16:18-23.
19. Yegn A, Ertug Zeki, Yilmaz M, Erman M. The effects of epidural anesthesia and general anesthesia on newborns at cesarean section. *Turkish Journal of Medical Sciences* 2003;33:311-4.
20. U.S. Food and Drug Administration. FDA review results in new warnings about using general anesthetics and sedation drugs in young children and pregnant women. (Accessed March 16, 2017, at https://www.fda.gov/downloads/Drugs/DrugSafety/UCM533197.pdf.)
21. Afolabi BB, Lesi FE. Regional versus general anaesthesia for caesarean section. *Cochrane Database Syst Rev* 2012;10:CD004350.
22. Staikou C, Paraskeva A, Karmaniolou I, Mani A, Chondrogiannis K. Current practice in obstetric anesthesia: a 2012 European survey. *Minerva Anestesiol* 2014;80:347-54.