Int J Clin Exp Med 2017;10(10):14738-14744
www.ijcem.com /ISSN:1940-5901/IJCEM0063326

Original Article

Observation about clinical effects of PCSA on postoperative analgesia after second cesarean section

Xiangnan Li[1*], Dongbo Shao[2*], Jing Qian[1], Guangdong Yu[1], Conghu Yuan[1]

[1]Department of Anesthesiology, Yancheng Third People's Hospital, Yancheng City, Jiangsu Province, China; [2]Department of Anesthesiology, Yancheng Second People's Hospital, Yancheng City, Jiangsu Province, China. [*]Equal contributors and co-first authors.

Received August 9, 2017; Accepted September 13, 2017; Epub October 15, 2017; Published October 30, 2017

Abstract: Objective: To compare the therapeutic effects between patient-controlled subcutaneous analgesia (PCSA) and patient-controlled epidural analgesia (PCEA). Methods: One hundred parturient women who underwent the second cesarean section in our hospital from June 2016 to February 2017 were accepted in this study. And they were equally divided into PCSA group and PCEA group by the random number table method. The postoperative follow-up indexes included the visual analogue scale (VAS) scores of the wound pain and uterine contraction pain at 4 h, 6 h, 24 h and 48 h after operation, the opioid dose within 6 h, 12 h, 24 h and 48 h after operation, the incidence of postoperative complications, the evaluation score of patients' satisfaction degree, the time of lactation and anal exhaust, the frequency of breastfeeding, the amount of vaginal bleeding and the off-bed activity time. Results: There was a statistically significant difference in the VAS scores between PCSA group (P=0.000) and PCEA group (P=0.003) at postoperative 4 h, 6 h, 24 h and 48 h. The VAS score at postoperative 6 h, 24 h and 48 h in PCSA group was lower than that in PCEA group (all P<0.001). The dosage of ropivacaine at postoperative 4 h, 6 h, 24 h and 48 h in PCSA group was obviously lower than that in PCEA group (all P<0.001). The incidence of nausea (P=0.027) and pruritus (P=0.014) in PCSA group was lower than that in PCEA group. And the patients' satisfaction degree of PCSA group was observably higher than that of PCEA group (P=0.004). Compared with the PCEA group, the time of lactation (P=0.021), anal exhaust (P=0.045) and off-bed activity (P=0.036) in PCSA group was advanced, the frequency of breastfeeding (P=0.007) in 24 h was increased while the amount of vaginal bleeding (P=0.001) was decreased. Conclusion: Compared with the PCEA, the PCSA can offer great therapeutic effects on wound pain and uterine contraction pain after the second cesarean section, reduce the incidence of postoperative adverse reactions and shorten the recovery time.

Keywords: Patient-controlled subcutaneous analgesia (PCSA), second cesarean section, postoperative analgesia

Introduction

With the introduction of the two-child policy in China, the number of parturient women in the second pregnancies admitted to medical institutions was increased significantly. For gravidas who had undergone the cesarean section in their first pregnancies, the rate for them to choose cesarean section in their second pregnancies was increased significantly [1]. The cesarean section can cause moderate-to-severe pain lasting 48 h after operation. And the poor postoperative analgesic effect not only can prevent puerperae to take care of their newborn babies, but also may give rise to some chronic pain symptoms which will seriously affect their quality of life [2]. The opioids have been commonly used to relieve the postoperative pain, and the methods of drug administration are mostly the epidural or intravenous injection [3, 4]. However, the side effects of opioids are also quite obvious, such as somnolence, respiratory depression, nausea, vomiting, and decreased gastrointestinal peristalsis, which are not conducive to the rapid recovery in patients [5, 6]. Therefore, it is necessary to find a new analgesic method or substitute for opioids to reduce the application and dosage of opioids [7].

Patient-controlled subcutaneous analgesia (PCSA), as a new analgesic method, can administrate the drugs at one time or continuously and relieve the postoperative pain effectively

[8]. Liu et al. have analyzed 44 papers about randomized controlled trials (RCTs) on local anesthetic postoperative analgesia of a series of different surgical modes, and claimed that PCSA can significantly relieve the pain after operation and had less catheter-related complications, which confirmed the effectiveness of PCSA application. Its specific clinical effects and convenient operation were beneficial to clinical promotion and application [9]. However, some scholars proposed that the postoperative PCSA required more rational-designed RCTs for study to ensure that more powerful evidences will be available for clinical guidance [10]. Nevertheless, there is no research about the clinical effects of PCSA on postoperative analgesia of the second cesarean section.

Therefore, one hundred parturient women who underwent the second cesarean section were accepted in this study for the comparison of therapeutic effects between PCSA and patient-controlled epidural analgesia (PCEA) on postoperative analgesia.

Materials and methods

Patient selection

This study was examined and approved by the Hospital Ethics Committee, and it also obtained informed consents from patients and their families. Parturient women who underwent the second parturient cesarean section in our hospital from June 2016 to February 2017 were included in this study.

Inclusion criteria: Parturient women who were going to undergo the second cesarean section; parturient women with a gestational age between 38 and 41 weeks; parturient women or their families who took the initiative to sign informed consents; parturient women who were willing to assist the completion of relevant examination. Exclusion criteria: Parturient women with gestational hypertension and medical or surgical complications; parturient women with the chronic pain; parturient women who were allergic to ropivacaine; parturient women who had a/history of painkiller dependence; parturient women with mental-related diseases; parturient women who did not want to cooperate with the treatment.

The included gravidas were randomly divided into PCSA group and PCEA group by the random number table method. Gravidas' general information including age, weight, gestational weeks and other data were collected after the grouping.

Treatment methods

Patients in both groups were treated with continuous epidural anesthesia.

PCSA group: puerperae were inserted with disposable catheters under fascia which were used to connect with the analgesic pump after cesarean sections. The composition of analgesic pump included 20 ml of 0.75% ropivacaine which was diluted to 100 ml with normal saline. And it was applied to infiltrate the wound to relieve the pain with in 48 h after operation. PCEA group: puerperae were required to undergo the PCEA after the cesarean section. The component of analgesic pump was 20 ml of 0.75% ropivacaine which was diluted to 100 ml with the normal saline. And it was employed to perform the epidural analgesia within 48 h after operation.

Parameters of analgesic pumps: both loading doses were 2 ml; dosages were maintained at 2 ml/h; the dosage for one time was 0.5 ml and the lockout period was 15 min. The experiment was conducted in a double-blind way, which meant that both of the medical staffs who implemented the analgesic pump and patients yet knew the anesthesia method.

Observation indexes

Main observation indexes: the VAS scores of the wound pain and uterine contraction pain at postoperative 4 h, 6 h, 24 h and 48 h.

Secondary observation indexes: the opioids dose within 6 h, 12 h, 24 h and 48 h after operation (it was applied when the VAS score ≥4); the incidence of postoperative complications; the evaluation scores of patients' satisfaction degree; the time of lactation and anal exhaust; the frequency of breastfeeding; the amount of vaginal bleeding and the off-bed activity time.

VAS score applies 11 numbers (from 0 to 10) to present the pain degree. Zero means painless and ten symbolizes the most painful. Patients were required to select a number in these 11 numbers to represent the pain degree according to their own conditions. Zero: painless;

Table 1. Comparison of patients' general information between the two groups

	PCSA group	PCEA group	F	P
Case	50	50		
Age (year)	31.3±11.0	32.1±13.3	0.86	0.891
Weight (kg)	73.3±22.2	71.9±19.0	0.951	0.766
Gestational weeks (weeks)	39.5±8.2	39.2±9.0	1.154	0.541
Duration of cesarean section (min)	75.3±10.6	72.3±9.4	1.497	0.138
Intraoperative bleeding amount (ml)	236.5±89.6	251.9±76.6	-0.924	0.358

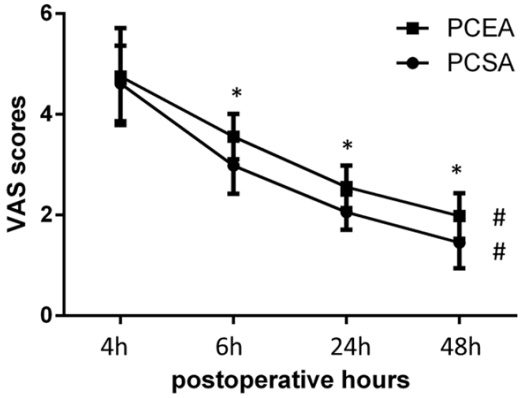

Figure 1. Comparison of VAS scores between the two groups. *P<0.001, comparison of VAS scores at specific points-in-time between PCSA group and PCEA group was conducted by t test; #P<0.005, comparison of VAS scores between four points-in-time in PCEA group or PCSA group was conducted by the repeated measures ANOVA. Data were expressed as mean ± sd.

scores under three points: slight pain which is tolerable; scores from four to six points: patients feel pain which has influenced their quality of sleep, but still tolerable; scores from seven to ten points: patients gradually feel great pain which is intolerable and their appetite and quality of sleep are decreased.

One day after the operation, self-made questionnaires of satisfaction degree were used to investigate the patients' postoperative satisfaction degree. The main contents included intraoperative discomfortableness, postoperative therapeutic effects, adverse reactions, postoperative recovery conditions and so on. The total score of questionnaire was 100 points: scores from 81 to 100 points meant that gravidas were greatly satisfied with the postpartum anesthesia; scores from 61 to 80 demonstrated that gravidas were generally satisfied with the postpartum anesthesia; scores under 60 points showed that gravidas were unsatisfied with the postpartum anesthetic effects. Satisfaction degree = (number of people who felt greatly satisfied + number of people who felt generally satisfied)/ overall number of people * 100%.

Statistical analysis

The commonly-used SPSS 17.0 software was applied to sort out and analyze the data. The measurement data were expressed as mean ± sd, and the comparison of measurement data from independent samples between two groups were applied with t-test. The enumeration data were presented as rate, and differences of independent samples between two groups were examined by χ^2. The comparison of VAS scores at multiple time points were analyzed by the repeated measurements of ANOVA. The difference was statistically significant when P<0.05.

Results

General information

One hundred parturient women in the second pregnancies were accepted in this study, and they were equally divided into PCSA group and PCEA group. There was no statistically significant difference between the two groups regarding the general information such as age, weight, gestational weeks, duration of cesarean section and intraoperative bleeding amount (all P>0.05). See **Table 1**.

VAS scores

There was a statistically significant difference between the VAS scores at postoperative 4 h, 6 h, 24 h and 48 h in PCSA group (P<0.001) and PCEA group (P=0.003). The VAS scores in PCSA group at postoperative 6 h, 24 h and 48 h were lower than those in PCEA group (all P<0.001), and the difference was statistically significant. See **Figure 1**.

Opioids dosage

The dosage of ropivacaine in PCSA group at postoperative 4 h, 6 h, 24 h and 48 h were

Table 2. Cumulative opioids dosage in the two groups

		PCSA group (n=50)	PCEA group (n=50)	t	P
Dosage of ropivacaine (μg)	Postoperative 4 h	79.0±23.3	112±22.3	-7.235	0.000
	Postoperative 6 h	101.2±22.3	152.8±35.1	-8.774	0.000
	Postoperative 24 h	198.7±59.5	285.2±33.2	-8.977	0.000
	Postoperative 48 h	235.2±69.0	334.5±38.2	-8.903	0.000

Table 3. Comparison of postoperative complications between two groups

	PCSA group (n=50)	PCEA group (n=50)	χ^2	P
Nausea	1	7	4.891	0.027
Vomiting	2	7	3.053	0.081
Pruritus	1	8	5.983	0.014
Bradycardia	0	0		
Hypotension	0	0		
Respiratory depression	0	0		

Table 4. Comparison of postoperative satisfaction degree between the two groups

	Greatly satisfied	Generally satisfied	Unsatisfied	Satisfaction degree
PCSA group (n=50)	32	14	4	92.0%
PCEA group (n=50)	20	13	17	66.0%
χ^2				10.854
P				0.004

obviously lower than that in PCEA group (all P<0.001). And the difference was statistically significant. See **Table 2**.

Complications

Postoperative symptoms such as sinus bradycardia, hypotension, and respiratory depression were not occurred in both PCSA group and PCEA group, but there appeared some adverse reactions including vomiting, nausea and pruritus in both groups. And the incidence of nausea (P=0.027) and pruritus (P=0.014) in PCSA group was lower than that in PCEA group. The difference was statistically significant. See **Table 3**.

Satisfaction degree

Gravidas' satisfaction degree for treatment were investigated and then statistically analyzed. The satisfaction degree of PCSA group was 92.0%: greatly satisfied (n=32), generally satisfied (n=14), unsatisfied (n=4). The satisfaction degree of PCEA group was 66.0%: greatly satisfied (n=20), generally satisfied (n=13), unsatisfied (n=17). The satisfaction degree of PCSA group was distinctly higher than that of PCEA group and the difference showed statistical significance (P=0.004). See **Table 4**.

Postoperative recovery status

Compared with PCEA group, the time of lactation (P=0.021), anal exhaust (P=0.045) and off-bed activity (P=0.036) in PCSA group was shorter, the frequency of breastfeeding (P=0.007) in 24 h was increased and the amount of vaginal bleeding (P=0.001) was decreased. The differences were statistically significant. See **Table 5**.

Discussion

The most ubiquitous one among gynecological surgeries is the cesarean section, and the pain and discomfort of wounds after operation can significantly influence the puerperae's postoperative activity, quality of sleep, lactation and so on [11, 12]. How to help puerperae go through the postoperative recovery period without feeling painful as much as possible has been one of the main problems that medical staffs have focused in recent years.

PCSA is consisted of infusion pump and implantable osmotic catheter. The implantable osmotic catheter is a distal porous polyurethane infusion catheter which can be placed subcutaneously, subfascially or supraperiosteally according to the operation types. The generation and conduction of nociceptive stimulus signal are blocked by the continuous infiltration of nerve endings with local anesthetic drugs by

Table 5. Comparison of postoperative recovery status between the two groups

	PCSA group (n=50)	PCEA group (n=50)	t	P
Time of lactation	31.9±5.2	34.2±4.6	-2.343	0.021
Frequency of breastfeeding in 24 h	12.0±2.1	10.9±1.9	2.747	0.007
Time of anal exhaust	18.8±3.6	20.3±3.8	-2.026	0.045
Time of off-bed activity	12.8±3.2	14.1±2.9	-2.129	0.036
Amount of vaginal bleeding	197.2±20.3	211.9±23.5	-3.347	0.001

the patient-controlled infusion pump. This device is quite simple to operate and has small impact on important organs, so it has been widely used in foreign countries and also has been included in the United States health care system after being approved by the FDA. Ranta et al. claimed that the therapeutic effects of the epidural local anesthetic analgesia and local anesthetic analgesia which implanted the catheter under fascia were comparatively the same [13]. There are some other studies which confirmed that the injection of local anesthesia around the incision could effectively reduce the opioids dosage and improve nausea, vomiting and other relevant complications, which had obvious advantages when compared with the traditional intravenous analgesia. However, due to the frequency of drug administration and the diversity of catheter position, the VAS scores at postoperative 48 h were not improved distinctly [14].

The results of our research confirmed that PCSA could effectively control the postoperative pain of second cesarean section and significantly reduce the application of opioids after operation, which was consistent with the relevant research results [15-17]. And PCSA could also reduce the incidence of complications of nausea and pruritus, which might because it had reduced the opioids application, since the occurrence of nausea and pruritus were often related with the use of opioids [18, 19]. Meanwhile, our research confirmed the therapeutic effects of continuous drug administration of PCSA after the second cesarean section, which could provide relevant clinical evidences for postoperative early recovery of puerperae, increase of satisfaction degree and better care of newborn babies.

Patients who underwent the cesarean section always accompanied by the great wound pain and uterine contraction pain, which might cause the sympathetic nerve excitement and increase the release of endogenous substances and bioactive substances. Then it can decrease the secretion of mammotrophic hormones and result in the difficulty of lactation [20, 21]. This experiment showed that first lactation time of puerperae who were treated with PCSA was obviously shortened and the frequency of breastfeeding was significantly increased. This probably because the better analgesic effects (the study has been confirmed) were more beneficial to the secretion of mammotrophic hormones, thereby stimulating the secretion of milk and increasing the success rate of breastfeeding. In addition, PCSA can be safely and efficiently applied to the analgesia after cesarean section, so as to conduct the continuous analgesia for incision pain of abdominal wall and uterine contraction pain after operation. Then it can quickly ease the anxiety and tension caused by pain, thereby promoting the physiological recovery of puerperae and making the secretion of milk ahead of time. This research also found that the first anal exhaust time of puerperae in PCSA group was better than that in PCEA group, suggesting that the recovery of gastrointestinal function of puerperae in PCSA was better than that in PCEA group. This might because PCEA needed to retain a catheter in epidural space to limit the patients' actions. And it delayed the patients' on-bed time, which influenced the intestinal peristalsis to some extent. However, the connection method of PCSA was quite simple, and the activities of puerperae were not restricted, which had small impact on the recovery of puerperae.

In summary, the application of PCSA on postoperative analgesia of the second cesarean section can obtain similar clinical effects of PCEA, and meanwhile reduce the dosage of ropivacaine and the incidence of nausea and vomiting after operation, which was more conducive to the recovery of patients. Therefore, it is necessary to further promote its application on clinic. Moreover, there may cause deviations of results for the lack of follow-up time and the small amount of samples in this study. Prospective trials with more samples and lon-

ger follow-up time will be conducted to approve the results of this study, so as to widely popularize the clinical application of PCSA on postoperative analgesia of second cesarean section.

Acknowledgements

This work was supported by Science and Technology Development Program of Yancheng City (YK2015110).

Disclosure of conflict of interest

None.

Address correspondence to: Conghu Yuan, Department of Anesthesiology, Yancheng Third People's Hospital, No. 75 Juchang Road, Yancheng City 224001, Jiangsu Province, China. Tel: +86-0515-81606533; E-mail: yuanch0801@163.com

References

[1] Wang HB, Zhou AL, Zhang AQ, Yan XH and Gao LC. Clinical analysis of nine cases of incomplete rupture of late pregnancy scarred uterus. Chinese Journal of Practical Gynecology and Obstetrics 2002; 18: 364.

[2] Eisenach JC, Pan P, Smiley RM, Lavand'homme P, Landau R and Houle TT. Resolution of pain after childbirth. Anesthesiology 2013; 118: 143-151.

[3] McDonnell NJ, Keating ML, Muchatuta NA, Pavy TJ and Paech MJ. Analgesia after caesarean delivery. Anaesth Intensive Care 2009; 37: 539-551.

[4] Weibel S, Jelting Y, Afshari A, Pace NL, Eberhart LH, Jokinen J, Artmann T and Kranke P. Patient-controlled analgesia with remifentanil versus alternative parenteral methods for pain management in labour. Cochrane Database Syst Rev 2017; 4: Cd011989.

[5] Hegmann KT, Weiss MS, Bowden K, Branco F, DuBrueler K, Els C, Mandel S, McKinney DW, Miguel R, Mueller KL, Nadig RJ, Schaffer MI, Studt L, Talmage JB, Travis RL, Winters T, Thiese MS and Harris JS. ACOEM practice guidelines: opioids for treatment of acute, subacute, chronic, and postoperative pain. J Occup Environ Med 2014; 56: e143-159.

[6] Martinez V, Guichard L and Fletcher D. Effect of combining tramadol and morphine in adult surgical patients: a systematic review and meta-analysis of randomized trials. Br J Anaesth 2015; 114: 384-395.

[7] White PF. The changing role of non-opioid analgesic techniques in the management of postoperative pain. Anesth Analg 2005; 101: S5-22.

[8] Dahl JB and Moiniche S. Relief of postoperative pain by local anaesthetic infiltration: efficacy for major abdominal and orthopedic surgery. Pain 2009; 143: 7-11.

[9] Liu SS, Richman JM, Thirlby RC and Wu CL. Efficacy of continuous wound catheters delivering local anesthetic for postoperative analgesia: a quantitative and qualitative systematic review of randomized controlled trials. J Am Coll Surg 2006; 203: 914-932.

[10] Rawal N, Borgeat A and Scott N. Wound catheters for post-operative pain management: overture or finale? Acta Anaesthesiol Scand 2012; 56: 395-396; author reply 397-398.

[11] Fouladi RF, Navali N and Abbassi A. Pre-incisional, post-incisional and combined pre- and post-incisional local wound infiltrations with lidocaine in elective caesarean section delivery: a randomised clinical trial. J Obstet Gynaecol 2013; 33: 54-59.

[12] Gadsden J, Hart S and Santos AC. Post-cesarean delivery analgesia. Anesth Analg 2005; 101 Suppl: S62-69.

[13] Ranta PO, Ala-Kokko TI, Kukkonen JE, Ohtonen PP, Raudaskoski TH, Reponen PK and Rawal N. Incisional and epidural analgesia after caesarean delivery: a prospective, placebo-controlled, randomised clinical study. Int J Obstet Anesth 2006; 15: 189-194.

[14] Li X, Zhou M, Shi X, Yang H, Li Y, Li J, Yang M and Yuan H. Local anaesthetic wound infiltration used for caesarean section pain relief: a meta-analysis. Int J Clin Exp Med 2015; 8: 10213-10224.

[15] Bech RD, Ovesen O, Lindholm P and Overgaard S. Local anesthetic wound infiltration for pain management after periacetabular osteotomy. A randomized, placebo-controlled, double-blind clinical trial with 53 patients. Acta Orthop 2014; 85: 141-146.

[16] Merritt CK, Mariano ER, Kaye AD, Lissauer J, Mancuso K, Prabhakar A and Urman RD. Peripheral nerve catheters and local anesthetic infiltration in perioperative analgesia. Best Pract Res Clin Anaesthesiol 2014; 28: 41-57.

[17] Rikalainen-Salmi R, Forster JG, Makela K, Virolainen P, Leino KA, Pitkanen MT, Neuvonen PJ and Kuusniemi KS. Local infiltration analgesia with levobupivacaine compared with intrathecal morphine in total hip arthroplasty patients. Acta Anaesthesiol Scand 2012; 56: 695-705.

[18] Nakatani T. [Opioid therapy and management of side effects associated with opioids]. Gan To Kagaku Ryoho 2017; 44: 294-297.

[19] Gunther T, Dasgupta P, Mann A, Miess E, Kliewer A, Fritzwanker S, Steinborn R and Schulz S. Targeting multiple opioid receptors-

improved analgesics with reduced side effects? Br J Pharmacol 2017.
[20] Chen YM, Li Z, Wang AJ and Wang JM. [Effect of labor analgesia with ropivacaine on the lactation of paturients]. Zhonghua Fu Chan Ke Za Zhi 2008; 43: 502-505.
[21] Zhang H, Wang C, Li X and Zhang Y. Effects of pterostilbene on treating hyperprolactinemia and related mechanisms. Am J Transl Res 2016; 8: 3049-3055.