ORIGINAL ARTICLE

Effect of Availability of a Parturient-elective Regional Labor Pain Relief Service on the Mode of Delivery

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Background/Purpose: Regional analgesia for labor pain relief is effective and widely used. This study evaluated the controversial association between mode of operative delivery and patient-elective labor regional analgesia.

Methods: We retrospectively compared the rates of instrumental vaginal and cesarean deliveries in parturients before the introduction, in the first 15 months after, and in the subsequent 36 months after the implementation of an elective labor regional analgesia service. A total of 9779 low-risk singleton cephalic pregnancies above 36 weeks of gestation were included. The maternal and fetal outcomes for parturients before the service was implemented and in those with or without pain relief service in the two postimplementation periods were analyzed. Multivariate logistic regression analyses were used to investigate the effects of maternal age, gestational weeks and newborn weight, in addition to regional analgesia, on the mode of delivery in nulliparous women.

Results: After adjusting for maternal age, gestational weeks, and newborn weight, no significant association was found between regional analgesia and cesarean delivery in nulliparas. Further, this lack of association was not affected by the receipt of regional analgesia in the early period of program implementation or in the period after staff had become familiar with the service. A higher rate of instrumental vaginal delivery was noted in nulliparas given regional analgesia.

Conclusion: Regional analgesia for pain relief increased the likelihood of instrumental vaginal delivery, but did not increase the likelihood of cesarean delivery. [*J Formos Med Assoc* 2006;105(9):722–730]

Key Words: cesarean delivery, instrumental vaginal delivery, regional analgesia

The use of regional analgesia for pain relief during labor has become increasingly common in obstetric practice. Intrapartum regional analgesia is now used by more than 50% of parturients in the United States.[1] Although this form of obstetric analgesia has been shown to be a safe and effective method of pain relief, there is controversy regarding the effect of regional analgesia on the rate of cesarean births due to the indication of dystocia.[2–7] Elevated rates of instrument-assisted vaginal delivery associated with the conduction of analgesia have also been reported.[5,6,8] Differences in study design have made it difficult to compare reported data on the effect of regional

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analgesia on labor. A higher risk of cesarean section for dystocia associated with epidural analgesia given at ≤ 4 cm of cervical dilatation, in comparison with epidural analgesia given at ≥ 5 cm of cervical dilatation has been reported.[4] Other variables significantly associated with cesarean section in previous studies included nulliparous or multiparous women, confirmation of active labor, a strict protocol for active labor management, and the use of consistent diagnostic criteria for dystocia.[3,4,9,10] In addition, the effects of regional analgesia on the mode of operative delivery (cesarean section *vs*. instrument-assisted vaginal delivery rates) may differ in populations with different baseline cesarean section rates.

The overall cesarean rate in Taiwan is about 34%, which is relatively high in comparison with some developed countries.[11,12] This high rate of cesarean birth has been of great concern to medical communities, the Bureau of National Health Insurance and associations for the promotion of women's rights. The purpose of this retrospective study was to examine the association of regional analgesia for labor pain relief given at ≥ 4 cm of cervical dilatation with the rate of cesarean and instrument-assisted vaginal deliveries in healthy pregnant women without a previous uterine operation who had a singleton cephalic gestation above 36 weeks in Taiwan.

Methods

The medical records of 21,915 parturients admitted to a medical center in Taiwan between January 1997 and December 2002 were reviewed. Before October 1998, the use of pain relief analgesia for parturients in this hospital was rare and was based on the anesthesiologists' discretion. Since October 1998, however, a 24-hour elective (on-patient-request) pain relief analgesia service has become available to patients in active labor. For the purposes of analysis in this study, parturients who delivered between January 1997 and September 1998 served as a historical control group. Parturients who delivered between October 1998 and December 1999 served as the pain relief group in the early phase of implementation of the service, representing the period when physicians and health care staff developed experience with related procedures. Parturients who delivered between January 2000 and December 2002 served as the later pain relief group, representing the period when health care staff had become accustomed to the availability and practice of related procedures. Those parturients who received pain relief service were further subdesignated according to their elective use of regional analgesia or not in the early and later postimplementation periods. Both nulliparous and multiparous women were included in the study. The association between the pain relief service and operative delivery mode was also separately assessed in nulliparas. Institutional review board approval was obtained to perform this retrospective study of information from the clinical database.

Routine intrapartum management of all parturients in this hospital included the following: continuous monitoring of fetal heart rate (FHR); pelvic examinations performed approximately every 2 hours to evaluate the progress of labor; and cervical changes < 1 cm/2 hours coincidental with a hypotonic contraction pattern measured by external pressure transducers resulting in oxytocin augmentation of labor. Dystocia was diagnosed when adequate uterine activity did not result in adequate progressive cervical dilatation or descent of the fetal head.[13] Vacuum use was the only method of operative vaginal delivery in this institute throughout the study. Indications for vacuum use were limited to inadequate voluntary pushing, maternal intolerance due to maternal health conditions, dystocia without a contracted pelvis, and non-reassuring FHR tracing, regardless of the use of the pain relief service. Inadequate voluntary pushing was diagnosed at bedside as a lack of descent due to inadequate maternal expulsive efforts. The standard protocols and methods applied in our hospital for cervical ripening, the use of oxytocin, evaluation of fetal distress and dystocia, and the management of prolonged labor remained the same during the 6-year study

period. No dramatic personnel changes among the supervisory obstetricians occurred during the study period.

Pain relief service with spinal or epidural analgesia was initiated on patient request by on-call anesthesiologists when the patient was in active labor with cervical dilatation ≥ 4 cm. Each fetus had a normal heart rate pattern before the induction of labor analgesia. Although there were individual variations, analgesia usually consisted of a continuous epidural infusion with 0.125% bupivacaine at an initial rate of 12 mL/hr, with the rate adjusted to achieve adequate pain relief. Other methods of analgesia initiated at the discretion of the anesthesiologist included one-shot spinal analgesia with opioids and bupivacaine, parturient-controlled epidural analgesia (PCEA), and combined spinal-epidural analgesia. The PCEA regimen was a 5 mL demand bolus dose of pure ropivacaine (2 mg/mL) delivered epidurally without a background infusion or the addition of other opioids as well as a lockout interval of 15 minutes and a maximum hourly allowance of 15 mL via a PCA pump (Model 9300, Graseby Herts, UK). The combined spinal-epidural analgesia regimen consisted of 0.5 mL of 0.5% bupivacaine (2.5 mg) with 25 μg fentanyl and 0.15 mg morphine injected into the subarachnoid space first. Once analgesia from the initial spinal injection had begun to wear off and the labor course was still in the first stage, the parturients received a continuous epidural infusion with 0.1% bupivacaine and 2 μg/mL fentanyl (10–12 mL/hr). The one-shot spinal analgesia regimen involved injecting 0.5 mL of 0.5% bupivacaine (2.5 mg) with 25 μg fentanyl and 0.15 mg morphine intrathecally. The medication was routinely discontinued for all parturients in the second stage of labor.

The following data were collected by review of delivery logs and medical records: maternal age, parity, gestational weeks, type of analgesia, type of delivery, medical or obstetrical complications, indication of operative delivery, neonatal birth weight, and Apgar scores of the newborn. Parturients in the pre- and postanalgesia service implementation periods with the following characteristics were included: complete analgesia records; healthy with uncomplicated singleton cephalic pregnancies above 36 weeks' gestation and without previous uterine operation (e.g. previous cesarean delivery, myomectomy, metroplasty, conization or repair of the uterus). Fifty-five parturients who had taken pain relief analgesia before October 1998 were excluded.

Statistical evaluation of the data was performed using SAS version 8.2 (SAS Institute Inc, Cary, NC, USA). Significance was determined using the χ^2 test, Fisher's exact test, the Mantel–Haenszel test and independent-samples t test, as appropriate. Logistic regression was employed for multivariate analysis. A value of $p < 0.05$ was considered to indicate statistical significance.

Results

Review of medical records identified 9779 parturients who met the inclusion criteria for the study, including 3527 prior to implementation of the service between January 1997 and September 1998, 2657 in the early period after implementation of the service between October 1998 and December 1999, and 3595 after familiarity with the service by health care staff between January 2000 and December 2002. The cesarean delivery rates, operative vaginal delivery rates, and pain relief service usage rates in parturients meeting the inclusion criteria are shown in the Figure. Table 1 shows the age, parity, gestational weeks and fetal outcome in the three groups. There was no significant difference between the three groups with regard to maternal characteristics, except for the distribution of maternal age and gestational weeks. The early and later postimplementation groups included a significantly lower percentage of women younger than 30 years ($p = 0.017$). The later postimplementation group had more pregnancies < 40 gestational weeks ($p = 0.007$). In both postimplementation groups, the majority of women with pain relief service were nulliparas ($p < 0.001$), were significantly younger ($p = 0.026$), and a significantly higher percentage had a gestational

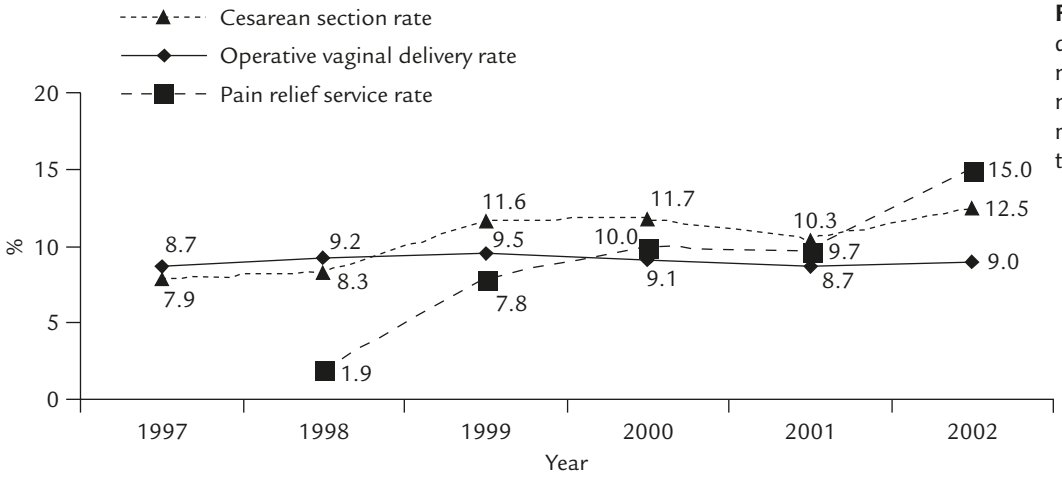

Figure. Rates of cesarean delivery and operative vaginal delivery in parturients meeting the inclusion criteria, and the usage rate of the pain relief service.

Table 1. Characteristics of parturients and fetal outcome before and after availability of a parturient-elective regional analgesia service

	Preimplementation ($n=3527$)	Postimplementation					
		Early			Later		
		Total ($n=2657$)	Without analgesia ($n=2429$)	With analgesia ($n=228$)	Total ($n=3595$)	Without analgesia ($n=3180$)	With analgesia ($n=415$)
Age (yr)							
Mean ± SD	30.9 ± 3.9	31.2 ± 4.1	31.2 ± 4.1	30.6 ± 3.6‡	31.2 ± 4.0	31.2 ± 4.1	30.7 ± 3.5‖
< 30 (%)	36.38	33.68†	33.10	39.91‡	32.29§	31.82	35.90‖
30–34 (%)	46.07	46.29	46.32	46.05	49.43	49.09	52.05
≥ 35 (%)	17.55	20.02	20.58	14.04	18.28	19.09	12.05
Parity							
Mean ± SD	1.6 ± 0.7	1.6 ± 0.7	1.6 ± 0.7	1.1 ± 0.4‡	1.5 ± 0.7	1.6 ± 0.7	1.1 ± 0.3‖
Nulliparas (%)	55.62	55.37	51.71	94.30‡	57.50	52.80	93.49‖
Multiparas (%)	44.38	44.63	48.29	5.70‡	42.50	47.20	6.51‖
Gestation (wk)							
Mean ± SD	39.2 ± 1.2	39.2 ± 1.2	39.2 ± 1.2	39.3 ± 1.2	39.1 ± 1.2	39.1 ± 1.2	39.3 ± 1.1‖
< 40 (%)	56.17	58.15	58.75	51.75‡	59.33§	60.09	53.49‖
≥ 40 (%)	43.83	41.85	41.25	48.25‡	40.67	39.91	46.51‖
Birth weight (g)							
Mean ± SD	3258.6 ± 393.5	3255.6 ± 394.6	3254.3 ± 397.1	3269.5 ± 368.0	3239.5 ± 390.4	3235. 6 ± 394.0	3269.6 ± 360.0
< 3000 (%)	24.33	26.19	26.39	24.12	25.42	25.97	21.20
3000–3499 (%)	49.90	47.12	47.10	47.37	50.32	49.81	54.22
3500–3999 (%)	22.57	23.79	23.43	27.63	21.67	21.67	21.69
≥ 4000 (%)	3.20	2.90	3.09	0.88	2.59	2.55	2.89
1 min Apgar							
< 7 (%)	1.79	1.96	1.93	2.19	2.31	2.14	3.61
5 min Apgar							
< 7 (%)	0.28	0.15	0.12	0.44	0.25	0.25	0.24
Lacerations* (%)	2.04	2.75	2.55	4.82‡¶	1.92	2.01	1.20

**Third- or fourth-degree and cervical lacerations; †$p<0.05$, compared with preimplementation and early postimplementation groups; ‡$p<0.05$, compared with early postimplementation groups with or without analgesia; §$p<0.05$, compared with preimplementation and later postimplementation groups; ‖$p<0.05$, compared with later postimplementation groups with or without analgesia; ¶$p<0.05$, compared with early and later postimplementation groups with analgesia.*

Table 2. Rates of operative delivery for nulliparas with or without pain relief service in the preimplementation period and the early and later periods of postimplementation*

Indications	Preimplementation ($n=1961$)	Postimplementation			
		Early		Later	
		Without analgesia ($n=1255$)	With analgesia ($n=215$)	Without analgesia ($n=1679$)	With analgesia ($n=388$)
Cesarean delivery					
Dystocia	8.16	9.16	13.49†	8.76	14.95‡
Non-reassuring FHR tracing	3.16	6.21	4.19	6.85	4.12‡
Others	1.58	1.91	0†	2.08	0.26‡
Total	12.90	17.29	17.67	17.69	19.33
Operative vaginal delivery					
Dystocia	0.20	0.08	0	0	0
Non-reassuring FHR tracing	0.36	0.24	0	0.18	0.52
Others	12.75	12.19	20.00†	10.42	18.30‡
Total	13.31	12.51	20.00†	10.60	18.81‡

**Data are presented as %; †$p<0.05$, compared with early postimplementation groups with or without analgesia; ‡$p<0.05$, compared with later postimplementation groups with or without analgesia. FHR = fetal heart rate.*

age above 40 weeks compared to the women without pain relief service ($p=0.021$). The newborn weight and Apgar scores at 1 and 5 minutes were not significantly different between parturients with or without regional analgesia. The rates of third- or fourth-degree and cervical lacerations were significantly higher in early postimplementation parturients who used the elective service ($p=0.045$), while this difference was not significant in the later postimplementation period. The rate of lacerations was also significantly higher in the early compared to late postimplementation groups among analgesia service users ($p=0.011$). In comparison with parturients in the preregional analgesia period (historical control), increased cesarean rates were found in both the early and later periods of implementation of the service because of non-reassuring FHR tracing in nulliparas and also an increased cesarean rate in the later postimplementation period because of dystocia in nulliparas (data not shown).

The rates of cesarean and operative vaginal deliveries in the nulliparas stratified by indications for cesarean birth and usage of the pain relief service in the different periods are shown in Table 2. There was a significantly higher cesarean delivery rate because of dystocia in the nulliparas with regional analgesia than in the nulliparas without regional analgesia ($p<0.001$). The rate of cesarean delivery due to non-reassuring FHR tracing was lower in the later postimplementation period among parturients who did not use the analgesia service ($p=0.005$). The operative vaginal delivery rates of nulliparas who used the pain relief service were higher than those of nulliparas who did not use the service in both early and later postimplementation periods ($p<0.001$) (Table 2). The increased rate for inadequate voluntary pushing (included in the "other" category) was the main indication for instrumental vaginal delivery. The overall operative delivery rates of the parturients who used the pain relief service were higher than those of the parturients who did not ($p<0.001$) (Table 2). The difference in operative delivery rates between the early and later postimplementation periods was not significant.

Table 3 shows the results of the multivariate analyses of maternal outcome in nulliparas,

Table 3. Coefficients of multivariate analyses of maternal outcome in nulliparas according to maternal and fetal characteristics and use of the pain relief service

	Preimplementation	Early postimplementation	Later postimplementation	All
Cesarean section				
Age (yr)	0.0971*	0.0948*	0.0785*	0.0903*
GA (wk)	0.2686*	0.3340*	0.2103*	0.2530*
BW (kg)	0.7066*	0.4327*	0.3142	0.4490*
PRS	–	−0.0886	0.0273	0.1319
Operative vaginal delivery				
Age (yr)	0.0695*	0.0812*	0.0338	0.0587*
GA (wk)	0.1209	0.1031	0.0736	0.1035*
BW (kg)	0.6690*	0.6977*	0.4980*	0.6218*
PRS	–	0.4926*	0.6151*	0.4815*

**p < 0.05. GA = gestational age; BW = birth weight; PRS = presence of pain relief service.*

Table 4. Coefficients of multivariate analyses for third- or fourth-degree and cervical lacerations in vaginal delivery in nulliparas

	Preimplementation	Early postimplementation	Later postimplementation	All
Lacerations				
Age (yr)	0.0214	−0.0007	0.0101	0.0105
GA (wk)	0.1296	−0.1243	−0.1567	−0.0540
BW (kg)	0.6755	0.6957	0.5280	0.6190*
PRS	–	0.0632	−1.0286*	−0.3762
Vacuum	1.1793*	1.2632*	1.0912*	1.1827*

**p < 0.05. GA = gestational age; BW = birth weight; PRS = presence of pain relief service.*

according to maternal and fetal characteristics and pain relief service. The multivariate analysis in the historical control (period before service implementation) showed that the cesarean delivery rate was associated with maternal age, gestational weeks and newborn weight. In the multivariate regression model for the nulliparas, the positive coefficients of age, gestational weeks and newborn weight indicated that older maternal age, pregnancies with a higher gestational age and heavier newborns were all factors associated with cesarean delivery. After adjustment for maternal age, gestational weeks and newborn weight, the use of the pain relief service was not associated with cesarean delivery in nulliparas in either of the postimplementation periods. Prior to service implementation, operative vaginal delivery was associated with maternal age and newborn weight in nulliparas. In the postimplementation periods, however, after adjustment for maternal age, gestational weeks and newborn weight, a significantly higher rate of operative vaginal delivery was found in nulliparas who used the pain relief service. The use of regional analgesia was associated with a 1.62-fold increase in the need for operative vaginal delivery (adjusted odds ratio, 1.62; 95% confidence interval, 1.30, 2.02). There was no significant difference in the rate of operative vaginal delivery between the two postimplementation groups.

Multivariate analysis of the association of third- or fourth-degree and cervical lacerations in vaginal delivery with maternal and fetal characteristics, pain relief service, and vacuum use in the nulliparas are shown in Table 4. Newborn weight and vacuum extraction were positively associated with local lacerations. After adjustment for maternal

age, gestational weeks, newborn weight and the use of vacuum extraction, the use of pain relief service was negatively associated with the risk of lacerations in the nulliparas in the later postimplementation group.

Discussion

The benefits of regional analgesia for pain relief during labor are primarily related to maternal comfort and satisfaction.[14] Other advantages of epidural and intrathecal analgesia for parturients, including easier vacuum application and less painful episiotomy repair, have been described.[15] A meta-analysis estimated a 10% increase in the cesarean birth rate for the indication of dystocia associated with epidural analgesia.[16] However, a negligible impact of regional analgesia initiated during early or late labor on the dystocia-related cesarean delivery rate has been reported in several other retrospective and prospective randomized studies.[3,6–9,17] In this study, patients with known confounding factors such as maternal or fetal medical complications, fetal malpresentation, obstetric complications such as placenta previa and antepartum hemorrhage, early initiation of analgesia at < 4 cm of cervical dilatation, and previous uterine operation, were excluded, and in our delivery ward, the protocol of the pain relief service was restricted for these parturients as described in the introduction.[18,19] We utilized both historical and simultaneous control, and stratified the nulli- or multiparous women for maternal outcome analysis. The clinical practice in this delivery ward remained similar during the 6-year study period. No significant change in the cesarean delivery rate associated with the rate of usage of regional analgesia was noted (Figure), similar to the findings of Segal et al.[20]

Since the distribution of maternal age and gestational weeks was different in the groups with and without regional analgesia (Table 1), a multivariate logistic regression model was used to analyze the relationship between the pain relief service and cesarean section, in order to consider the effects of maternal and fetal characteristics simultaneously. The results showed that the use of the pain relief service was not significantly associated with an increase in the need for cesarean delivery in nulliparas, after adjusting for maternal age, gestational weeks and newborn weight (Table 3), which is similar to the findings of Yancey et al.[21] The elevation of the cesarean rate in nulliparas who used the regional analgesia service was associated with several demographic and pregnancy characteristics. Older maternal age, more gestational weeks and heavier fetus were risk factors for cesarean delivery in the period before implementation of the service (Table 3). Women with gestation above 40 weeks and with heavier fetuses were more likely to request for the pain relief service in this series, which was attributed to their longer labor course (Table 1). In addition, as previously reported, patients who had an exceptional degree of pain, a higher level of anxiety, a longer labor course and protracted labor possibly secondary to dystocia for unidentifiable reasons, were more inclined to use the pain relief service.[10] Therefore, nulliparas with characteristics associated with dystocia and cesarean delivery were more likely to use the pain relief service, explaining the higher dystocia-related cesarean delivery rate in users of regional analgesia than in nonusers.

An increase in the operative vaginal delivery rate associated with the use of regional pain relief analgesia was found in this series (Table 3). The relationship between regional analgesia and operative vaginal delivery is controversial.[8,21–24] However, lacerations, the most common complication of vacuum extraction, were found to be related to the use of the vacuum itself rather than to regional analgesia after adjusting for maternal and pregnancy characteristics (Table 4). Epidural analgesia makes vacuum extraction easier because of the dense epidural block and local muscle relaxation.[15] Therefore, the local lacerations may not have been related to the use of the pain relief service.

The instability of the usage rate of an on-demand regional analgesia and the lack of familiarity with the method have been considered to

influence results on the association between the pain relief service and operative delivery rates.[15,21] In this study, the similar results during the early and later postimplementation periods showed a stable effect of regional analgesia on the mode of delivery following the introduction of the service in this hospital. However, the decrease in the laceration rate in the later period among parturients using the analgesia service in comparison with that in the early postimplementation period suggests that the familiarity of the obstetric staff with the effects of the use of the pain relief service may minimize possible complications.

The methods of regional analgesia were not analyzed in this study due to previous findings of lack of significant differences in the effects on duration of labor, visual analog pain scale scores, and mode of delivery associated with the conduction of standard continuous epidural infusion, PCEA, intrathecal analgesia, and combined spinal-epidural analgesia.[25–27] A significant decrease in the rate of cesarean delivery for non-reassuring FHR tracing in the later postimplementation period was found in regional analgesia users compared to nonusers, similar to the findings of Yancey et al.[21] This may have resulted from parturients with intermittently non-reassuring fetal tests being refrained from using the pain relief service in our series.

In conclusion, this study found that pain relief by regional analgesia did not increase the risk of cesarean delivery in nulliparas after adjustment for maternal age, gestational weeks and newborn weight. Regional analgesia was associated with an increased instrumental vaginal delivery rate after adjustment for maternal age, gestational weeks and newborn weight. Prenatal care providers should routinely discuss the option of elective regional analgesia with women during their pregnancies.

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