outside hospital; part of the reason was that black people were less likely to have cardiopulmonary resuscitation started by a bystander than were white people.⁴ It may be worth examining the way the public responds to cardiac arrest in different groups.

CONCLUSION

The most impressive predictor of survival was if the cardiopulmonary resuscitation was performed in hospital rather than outside. This may be related to several factors that have been found to predict survival—such as time to starting resuscitation^{5,9} and the skill and resources available to the resuscitation team. Since long term survival seems to be similar after initial resuscitation, whether this occurs in or outside hospital (81% over two years), any improvement in the success of cardiopulmonary resuscitation outside hospital would be beneficial.

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Epidural anaesthesia and low back pain after delivery: a prospective cohort study

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Abstract

Objective—To determine whether epidural anaesthesia during labour and delivery is a risk factor for postpartum back pain.

Design—Prospective cohort study with follow up at one day, seven days, and six weeks after delivery.

Setting—Teaching hospital in Montreal.

Subjects—329 women who delivered a live infant(s) during the study period. Exclusion criteria were back pain before pregnancy and delivery by elective caesarean section.

Intervention—Epidural anaesthesia during labour and delivery.

Main outcome measures and results—The primary outcome variable was development of postpartum low back pain. Back pain was quantified with self reports (yes/no), a pain score (numeric rating scale), and degree of interference with daily activities. Of the 329 women, 164 received epidural anaesthesia during labour and 165 did not. The incidence of low back pain in epidural v non-epidural group was 53% v 43% on day one; 21% v 23% on day seven; and 14% v 7% at six weeks. The relative risk for low back pain (epidural v non-epidural) adjusted for parity, delivery, ethnicity, and weight was 1.76 (95% confidence interval 1.06 to 2.92) on day one; 1.00 (0.54 to 1.86) on day seven; and 2.22 (0.89 to 5.53) at six weeks. There were no differences between the two groups in pain scores or the frequency of interference with daily activities. Similar results were obtained in the subgroup of women with low back pain of new onset—that is, those women with no back pain during their pregnancy.

Conclusions—Postpartum low back pain was common but decreased considerably over the short term. The association between epidural anaesthesia and postpartum low back pain was inconsistent over time with a significantly increased risk of low back

pain (epidural v non-epidural) noted only on the first day after delivery.

Introduction

Over the past 35 years epidural anaesthesia has been used to provide effective pain relief for women during labour and delivery. Two retrospective surveys in the United Kingdom have suggested an association between epidural anaesthesia and long term low back pain of new onset after delivery.^{1,2} In both studies women receiving epidural anaesthesia during labour and delivery were almost twice as likely to develop back pain after delivery as women not given epidural anaesthesia. Both surveys, however, were compromised by their retrospective design and low response rate. The objective of our prospective cohort study was to determine whether epidural anaesthesia during labour and delivery was a determinant of postpartum low back pain.

Methods

All women attending the (tertiary level) labour and delivery unit of the Royal Victoria Hospital in Montreal for delivery of a live infant(s) were eligible for study. Women who before pregnancy had a history of back pain requiring medical attention were excluded as there is evidence that such pain may be an independent risk factor for postpartum back pain.³ Also excluded were women undergoing elective caesarean section as spinal anaesthesia rather than epidural anaesthesia was the standard for this procedure.

A prospective cohort study design was used, with the exposure of interest being epidural anaesthesia during labour and delivery (yes/no). Epidural anaesthesia was performed on request, with six obstetric anaesthetists participating in the study. The anaes-

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thetic regimen was not standardised, but similar protocols were used—that is, epidural analgesia was established with 10–12 ml bupivacaine 0.25% followed by boluses of 8 ml bupivacaine 0.25% as required and the use of lignocaine or chlorprocaine for second stage analgesia. Difficulty in establishing epidural anaesthesia was defined a priori as more than three needle insertions or two or more intervertebral spaces tried before success.

The primary outcome variable was development of postpartum low back pain (yes/no). Back pain was also quantified by using a self report numeric rating scale ranging from 0–10, with 0 representing no pain and 10 representing the worst pain imaginable. This pain scale has been shown to be both reliable and valid in adults with the chronic pain syndrome.⁴ Lastly, the degree of functional impairment associated with low back pain was also assessed. Functional impairment was categorised as interference with daily activities sufficient to require analgesia or physician consultation (yes/no), or both. All subjects were interviewed by a trained research nurse at one day, seven days, and six weeks after delivery. The research nurse was blind to the study hypothesis, with blinding enhanced by the inclusion of questions on postpartum gastrointestinal and genitourinary symptoms.

Information on potential confounding variables—that is, age, parity, method of delivery (vaginal versus emergency caesarean section), ethnicity, socioeconomic status, weight gain during pregnancy, weight at delivery, time in stirrups, and history of low back pain during pregnancy—was also collected on both groups. Socioeconomic status was quantified with the two factor score developed by Green.⁵

Two retrospective surveys have shown that the incidence of postpartum low back pain in women not receiving epidural anaesthesia during labour and delivery is around 12%.^{1,2} Therefore, on the basis of an α error of 5% and an estimated prevalence of postpartum back pain in the non-epidural group of 12%, to provide 80% power to detect a “clinically important” relative risk of 2.0 (that is, a twofold increased risk of low back pain among women receiving epidural anaesthesia), about 160 women in each group were required.⁶ Subjects were recruited over 12 months (May 1992 to April 1993).

The frequency of low back pain in each group (epidural and non-epidural) at one day, seven days, and six weeks postpartum was estimated. These data were then used to calculate a crude or unadjusted relative risk—that is, the risk of postpartum low back pain among women receiving epidural anaesthesia

compared with women not given epidural anaesthesia for each of the three time points. Confidence intervals around the point estimates were derived with Miettinen’s test based method.⁷

In addition, to take into account differences in the distribution of potential confounding variables across the two groups, multivariate logistic regression analysis was used to provide adjusted relative risk estimates for the association between epidural anaesthesia and low back pain. Stepwise logistic regression analysis was used to build the multivariate model, with α to enter and α to exit levels at 0.15 and 0.20, respectively.⁸ (Logistic regression provides odds ratio estimates; given the infrequency of low back pain, however, odds ratios were taken to approximate relative risks.) Differences in the pain scores on the numeric rating scale between the two groups were tested with the non-parametric Mann-Whitney U test whereas differences in the proportion of women in each group with functional impairment because of low back pain were tested with the χ^2 test (P values < 0.05 were considered significant).

Data analyses were performed both on the entire sample and on the subgroup of women with no history of low back pain during their pregnancy. For the latter group, the development of postpartum low back pain was defined as “new onset” back pain.

Results

In total, 329 women enrolled in the study (only one eligible subject declined to participate). Of these, 164 women received epidural anaesthesia during labour and delivery, and 165 did not. Table I shows the baseline characteristics of the two groups. There were no differences between the two groups on age, socioeconomic status, weight at delivery, weight gain during pregnancy, or history of low back pain during pregnancy. Women in the epidural group, however, were significantly more likely to be primiparous, to be white, to have delivered by emergency caesarean section, and to have spent longer in stirrups during the second stage of labour.

Based on the a priori entry and exit criteria stepwise model building resulted in a final logistic regression model that included five variables—that is, the exposure of interest (epidural anaesthesia, yes/no) as well as parity, method of delivery, ethnicity, and weight at delivery. Therefore, logistic regression analysis quantified the relation between epidural anaesthesia and the risk of postpartum low back pain while taking into account differences between the two groups (epidural and non-epidural) on important confounders. The final logistic regression model was considered biologically plausible for two reasons. Firstly, previously published studies had shown that the variables included in the model were potential confounders of the association between epidural anaesthesia and postpartum low back pain,^{1–3} and, secondly, there were clear differences in the distribution of these variables between the two groups.

The frequency of low back pain was highest in both groups on day one after delivery with around half the women in both groups complaining of low back pain. Table II gives further details and the crude and adjusted relative risks over time. Follow up at one day and seven days was complete; three patients (two from the epidural group and one from the non-epidural group), however, were lost to follow up at six weeks.

The pain scores on the numeric rating scale were clearly skewed to the right given that most women in both groups reported no back pain (that is, a score of 0) at one day, seven days, and six weeks after delivery. Non-parametric testing with the Mann-Whitney U test showed no significant differences in pain scores

TABLE I—Baseline characteristics of women according to whether they received epidural anaesthesia during delivery

Characteristic	Epidural (n=164)	Non-epidural (n=165)	P value
Mean (SD) age (years)	29 (4.7)	30 (4.7)	0.105
Mean (SD) time in stirrups (minutes)	77 (35.9)	45 (27.5)	< 0.01
Mean (SD) weight at delivery (kg)	75 (12.6)	73 (12.2)	0.306
Mean (SD) weight gain (kg)	15 (4.9)	14 (4.4)	0.169
Mean (SD) socioeconomic status (Green scores*)	63 (9.9)	62 (8.9)	0.288
No (%) primiparous	84 (51)	31 (19)	< 0.01
No (%) who had caesarean section	11 (7)	2 (1)	< 0.01
No (%) white	144 (88)	125 (76)	< 0.01
No (%) who had back pain during pregnancy	56 (34)	58 (35)	0.939

TABLE II—Incidence of back pain after delivery in 164 women who received epidural anaesthesia and 165 who did not

Time after delivery	No (%) in epidural group	No (%) in group without epidural	Crude relative risk	Adjusted relative risk* (95% confidence interval)
One day	87 (53)	71 (43)	1.23	1.76 (1.06 to 2.92)
Seven days	34 (21)	38 (23)	0.91	1.00 (0.54 to 1.86)
Six weeks	23 (14)	12 (7)	2.00	2.22 (0.89 to 5.53)

*Adjusted for parity, delivery, ethnicity, and weight of patient.

TABLE III—Pain scores on numeric rating scale for back pain after delivery for all women and those who experienced no back pain during pregnancy according to whether they had epidural anaesthesia during delivery. Figures are median (range) scores

Time after delivery	All women			Women with back pain of new onset		
	Epidural (n=164)	Non-epidural (n=165)	P value*	Epidural (n=108)	Non-epidural (n=108)	P value*
One day	1 (0-8)	0 (0-8)	0.05	1 (0-8)	0 (0-8)	0.09
Seven days	0 (0-7)	0 (0-8)	0.616	0 (0-7)	0 (0-7)	0.815
Six weeks	0 (0-9)	0 (0-5)	0.086	0 (0-9)	0 (0-5)	0.148

*Mann-Whitney U test.

TABLE IV—Incidence of back pain of new onset and functional impairment in women who had not experienced back pain in pregnancy according to whether they had or had not received epidural anaesthesia during delivery

Detail	No (%) in epidural group (n=108)	No (%) in group without epidural (n=108)	Crude relative risk	Adjusted relative risk* (95% confidence interval)	P value
Back pain of new onset:					
One day	56 (52)	42 (39)	1.33	2.05 (1.07 to 3.92)	
Seven days	22 (20)	23 (21)	0.95	1.09 (0.48 to 2.48)	
Six weeks	16 (15)	8 (7)	2.14	3.17 (0.91 to 11.03)	
Functional impairment:					
One day	18 (17)	23 (21)			0.453
Seven days	8 (7)	3 (3)			0.197
Six weeks	2 (2)	1 (1)			0.529

*Adjusted for parity, delivery, ethnicity, and weight of patient.

between the two groups at one day, seven days, or six weeks. Table III provides the median pain scores for the two groups. Likewise, there were no differences between the two groups in the proportion of women reporting interference with daily activities because of low back pain. On the first day after delivery 30 (18%) women in the epidural group compared with 35 (21%) women in the non-epidural group complained of interference with activities ($P=0.490$). At seven days these figures were 11 (7%) and 10 (6%). At six weeks only three (2%) women in each group complained of interference with daily activities because of low back pain ($P=0.704$).

Establishment of epidural anaesthesia was considered difficult in 11 women (7%). The risk of low back pain in this subgroup, however, was not significantly different from the risk in those women in whom establishment of epidural anaesthesia was not considered difficult.

In total, 108 women in each group had no history of low back pain during their pregnancy. Table IV gives details of the analyses on this subgroup of women and shows the results to be similar to those for the entire sample. There were also no differences between the two groups on pain scores at one day, seven days, or six weeks after delivery (median pain scores are shown in table III). Table IV also shows that there were no differences between the two groups in the proportion of women with functional impairment because of low back pain of new onset.

Discussion

This prospective cohort study found that the incidence of low back pain on the first day after delivery was significantly higher in women who had received epidural anaesthesia during labour and delivery than in women not given epidural anaesthesia. Over time, the incidence of low back pain declined in both groups (from around 50% on day one to around 10% at six weeks) with no differences in incidence of back pain noted between the two groups at seven days or six weeks postpartum. Although not significant, however, the risk of low back pain at six weeks was about twice as high among women in the epidural group as in the non-epidural group. This trend in relative risk of low back pain (epidural *v* non-epidural)—that is, significant on day one, diminution by day

seven, yet increasing again by week six postpartum—was also noted in the subgroup of women with back pain of new onset—that is, women with no history of back pain during their pregnancy.

The research nurse recruited patients the morning after delivery during the regular working week only (Monday to Friday). Therefore, women delivering on Friday or Saturday and discharged home over the weekend were missed. Sample distortion bias was considered unlikely, however, for several reasons. Firstly, women were missed whether or not they had received epidural anaesthesia; secondly, patient demographics for the labour unit were similar by day; and, lastly, both the obstetricians and anaesthetists were on a rotating work schedule. Information bias was minimised by using a trained research nurse who was blind to the study hypothesis. Confounding bias was dealt with by using multivariate logistic regression analysis to provide adjusted relative risks—that is, risk estimates that took into account the effects of differences in the distribution of potential confounding variables, such as parity and method of delivery, across the two groups.

PREVIOUS STUDIES

Three controlled studies have examined the relation between epidural anaesthesia and postpartum low back pain, with conflicting results.¹⁻³ The two retrospective studies suggested that epidural anaesthesia was a major risk factor for long term low back pain of new onset after delivery.^{1,2} Macarthur *et al* found a 19% incidence of chronic back pain (backache within three months of delivery and persisting for over six weeks) among women who had received epidural anaesthesia during labour and delivery compared with an 11% incidence among women who had not received epidural anaesthesia.¹ Russell *et al* found a similar increased risk of low back pain among women who had received epidural anaesthesia compared with women who had not (18% *v* 12%, respectively).² Both studies, however, were compromised by the same methodological limitations. Firstly, the response rate was poor, with only 40% and 63% of women respectively responding to the two surveys. Secondly, both studies were retrospective, with follow up data collected a minimum of 12 months and maximum of nine years after delivery in the Macarthur survey and at 12-15 months after delivery in the Russell survey. These limitations raise the issues of accuracy and bias. For example, whether it is possible to pinpoint accurately the date of onset and describe the clinical course of a backache up to nine years after delivery is debatable. In addition, it could be argued that women with complaints were more likely to respond, in particular, those women who had received epidural anaesthesia. The possibility of recall bias in the retrospective studies is supported by data (collected before both surveys) that showed that women in the United Kingdom believed epidural anaesthesia to be a risk factor for low back pain.⁹ Both retrospective studies, however, carefully examined the social and clinical differences between responders and non-responders and found no obvious source of bias associated with the low response rates. A prospective exploratory study by Breen *et al* examined the relation between eight predictor variables (age, weight, height, mode of delivery, birth weight, epidural anaesthesia, history of back pain before pregnancy, and back pain during pregnancy) and self reported back pain two to four months after delivery.³ The incidence of back pain was not related to epidural use—that is, 44% of women in the epidural group reported back pain compared with 45% of women in the non-epidural group.

STRENGTHS AND WEAKNESSES

Causal inference is strongest when the evidence is

Key messages

- Epidural anaesthesia during delivery has been linked to an increased incidence of low back pain later
- Women who underwent epidural anaesthesia during delivery had an increased incidence of low back pain only on the first day after delivery, possibly because of local musculoligamentous trauma associated with insertion of the needle
- At seven days and six weeks after delivery there was no difference in the incidence of low back pain in women who did not have epidural anaesthesia
- General practitioners, obstetricians, anaesthetists, and midwives can assure women that any increased risk of low back pain after epidural anaesthesia is small and transient

provided by a randomised controlled trial. At this time, however, alternative techniques of pain control for use in labour are not as effective as epidural anaesthesia; a randomised trial of epidural versus non-epidural anaesthesia was, therefore, considered unethical. The strengths of our study included a prospective design and a high response rate with less than 1% of subjects lost to follow up. In addition, low back pain was quantified with a reliable and valid measure, and relative risk estimates were adjusted on parity, mode of delivery, ethnicity, and weight at delivery by using logistic regression analysis. The incidence of low back pain of new onset was also estimated by using the subgroup of women with no history of back pain during their pregnancy. Lastly, the study had greater than 90% power to determine a "clinically important" twofold difference in risk of low back pain between the epidural and non-epidural groups at one and seven days after delivery (both for the entire sample and the subgroup of women with back pain of new onset).

One important limitation of the study, however, was low statistical power at six weeks postpartum. That is, based on the incidence of back pain at six weeks this study had only around 50% power to detect a twofold difference in risk of low back pain between the two groups. This is an important issue given the provocative findings at six weeks postpartum—that is, a twofold increased risk of low back pain (epidural *v* non-epidural) in the entire sample and threefold increased risk of back pain in the subgroup with back pain of new onset. The lack of physical examinations was also a limitation as was the inability of the interview questions to capture precisely the quality of the pain—for example, to distinguish whether the back pain was localised and superficial or deep and generalised. In addition, women in the two groups were not formally compared on their attitudes towards pain. (To our knowledge, there are no published data on this issue.) If women with a lower pain threshold were more likely to request epidural anaesthesia, however, it could be argued that these women would also have been more likely to report low back pain. Therefore, any bias would have been towards overestimating rather than underestimating the relative risk (epidural *v* non-epidural).

INTERPRETATION OF FINDINGS

The significantly increased incidence of low back pain in the epidural group on day one might be explained by the local musculoligamentous trauma

associated with insertion of an epidural needle. This hypothesis could not be tested, however, as specific data on quality of pain were not collected. In addition, although a substantial proportion of women reported postpartum back pain at seven days (around 20%) and at six weeks (around 10%), the degree of pain was minimal with only one patient at seven days (in the non-epidural group) and two women at six weeks (one in each group) consulting a physician because of the back pain.

The association between epidural anaesthesia and low back pain has been hypothesised to result from poor posture during labour and delivery because of muscular relaxation, lack of mobility, and effective analgesia. Russell *et al* assessed women complaining of backache after delivery and found that 94% had primarily postural backache.² The immobility associated with epidural anaesthesia usually lasts less than 12 hours; it could be argued, therefore, that the physiological changes associated with pregnancy and the maternal workload after delivery are more biologically plausible risk factors for postpartum back pain. During pregnancy there is enormous strain on the lower back because of increasing lumbar lordosis, loss of abdominal muscle support, and a rise in the body's centre of gravity.¹⁰ After delivery, when the abdominal muscles are still weak, women must engage in repetitive lifting of the baby, often in the forward bent and twisted positions. These motions are recognised risk factors for low back pain.¹¹

In summary, low back pain after delivery is common, but the incidence decreases considerably over the short term, from around 50% on day one to around 10% at six weeks. Most women complaining of low back pain do not seek medical attention. Epidural anaesthesia was associated with a twofold to threefold increased risk of low back pain on day one and six weeks after delivery but no increased risk on day seven. Significance was noted only on day one. Prospective follow up data are required to determine whether epidural anaesthesia is associated with long term low back pain after delivery.

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Correction

Do changes in cardiovascular risk factors explain changes in mortality from stroke in Finland?

An editorial error occurred in this paper by Vartanen *et al* (8 April, pp 901-4). In figure 3 the symbols for diastolic blood pressure were transposed with those for all risk factors; thus the variables are, from top to bottom, smoking, all risk factors, diastolic blood pressure, and observed mortality.