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Audit of the influence of body mass index on the performance of epidural analgesia in labour and the subsequent mode of delivery

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Objective To assess the influence of body mass index (BMI) on the performance of epidural analgesia in labour and the subsequent mode of delivery.

Design A retrospective audit of prospectively collected quality assurance data.

Setting The delivery suite of Leeds General Infirmary, Leeds, UK. This is a 4500-delivery teaching hospital unit.

Population All women receiving epidural analgesia during labour in our unit between April 1997 and December 2005.

Methods Epidural recipients were divided into BMI groups according to World Health Organization (WHO) categories and compared for indices of epidural performance and mode of delivery.

Main outcome measures Midwife and patient satisfaction scores with epidural analgesia, epidural resite rates, and mode of delivery.

Results Data from 13 299 epidural recipients were analysed. Using WHO definitions, 22.8% were of normal body mass, 41.9% were overweight, 31.9% obese, and 3.4% morbidly obese. Epidurals were more likely to fail as BMI increased, as judged by midwife satisfaction scores ($P < 0.001$) and epidural resite rates ($P < 0.01$). This trend was not seen for maternal satisfaction scores using the WHO BMI categories. However, if women with BMI below 30 kg/m^2 were grouped together, a significant trend was found ($P < 0.01$). BMI had no influence on vaginal instrumental deliveries, but caesarean section rates rose from 11.5% in women of normal BMI to 29.2% in the morbidly obese women ($P < 0.001$).

Conclusions Obesity increases the incidence of analgesic failure and the need for resite of epidurals. The caesarean section rate among epidural recipients increases dramatically as BMI rises.

Keywords Caesarean section, epidural analgesia, labour, obesity, pregnancy.

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Introduction

The adverse effects of obesity in pregnancy and labour are well documented and its relevance to anaesthetists has also been reviewed.[1,2] Although it is known that caesarean deliveries are more frequent among obese women,[3–5] it is not known how the combination of obesity and epidural analgesia affects obstetric outcomes. Similarly, we are not aware of any published evidence concerning the performance of epidural analgesia among obese women. The large data set presented here, produced in the performance of routine quality assurance in obstetric anaesthesia, gives us the opportunity to address both these issues. The information produced may be of value to obstetricians, midwives, and women when formulating birth plans, obstetric anaesthetists in the process of obtaining informed consent for epidural analgesia, and to those involved in health counselling for obese women.

Methods

This audit was a retrospective analysis of routinely collected, anonymised quality assurance data. The audit was discussed with the chairman of the local research and ethics committee, but no formal application to the committee was made.

In April 1997, a computerised epidural audit system (Wansbeck Epidural Audit System; Xentec, Sunderland UK) was introduced in our obstetric unit. It functions in the following way. After taking consent and performing the epidural, the anaesthetist logs the details on a computer on the delivery suite. Recorded data include patient demographics,

progress and stage of labour, analgesia used prior to the epidural request, and detailed procedural information about the epidural itself. As well as generating a printed clinical record, the system stores the data in a Microsoft Access database. Follow-up forms are also produced: one for the midwife who makes note of her assessment of epidural efficacy and any complications, as well as the mode of delivery. The second form is used at routine postnatal follow up the next morning by the anaesthetists to collect data regarding analgesic efficacy, patient satisfaction, and complications. Members of the anaesthetic team enter information from both the forms into the database on a daily basis.

Some of the data fields of relevance to this study require further explanation.

Body mass index

Women's height and weight are not routinely measured in late pregnancy in our unit, and it was not considered practical to do so during labour for the sake of this audit. Anaesthetists are therefore instructed to ask women for this information when epidural analgesia is requested. Most women know their own height, but if not, it is estimated. Very few women know their precise body weight in late pregnancy. In this circumstance, an estimate of body weight is discussed with the woman and her partner based on her last known weight and on her appearance. In the absence of a recognised normal range for body mass index (BMI) in pregnancy, data analysis began with dividing the records into the BMI groups used by the World Health Organization (WHO) to define normality and obesity.

Midwife and patient satisfaction scores

After delivery, our midwives pass judgement on the overall performance of epidurals using a 4-point satisfaction scale. They choose one of four descriptive terms: 'excellent', 'satisfactory', 'poor', or 'useless'. The follow-up anaesthetist uses the same scale the day after delivery to gauge patient satisfaction. This scale was empirically chosen at the start of this audit project and is not a recognised scientific tool. However, it has been used by two of this study's authors (M.D. and J.B.) as an outcome measure in several studies previously published in peer-reviewed anaesthetic journals.[6,7] In this sense, benchmarks of satisfaction using this scale exist. For the purpose of this analysis, 'excellent' and 'satisfactory' were regarded as successful and 'poor' and 'useless' as failure.

While demographic and procedural data are available on all women logged into the system, follow-up forms are not always completed and returned by midwives. Similarly, some anaesthetic follow-up data are lost because of pressures of work or early patient discharge. The denominator figure for each outcome considered in this audit therefore differs from the total number of performed procedures.

Data were collated using Microsoft Access version 2.0 and Microsoft Excel 2002. Continuous data were analysed by analysis of variance (Excel 2002 with Analyse-it Software 2005 version 1.73, Leeds, UK). Discrete data were compared using the chi-square test and chi-square test for trend on Microsoft Excel 2002 using methodology described by Armitage and Berry.[8] Significance level was taken at $P < 0.05$.

Results

Data from 13 299 epidural recipients were analysed. Using WHO definitions, no women were underweight, 22.8% were of normal body mass, 41.9% were overweight, 31.9% obese, and 3.4% morbidly obese. There were differences between the BMI groups for age and parity (Table 1). However, the age differences were small and did not follow a trend for increasing BMI. Similarly, although there were significant differences in the proportion of primiparous women between the BMI groups (chi-trend statistic 14.9, $P < 0.01$), there was no trend with increasing BMI.

Data regarding mode of delivery were available on 12 572 (94.5%) of the entire data set. Table 2 shows that there was no relationship between BMI and delivery by low forceps/ventouse or midcavity rotational forceps. However, there was a highly significant trend for increasing caesarean section rate as BMI increases. This was true both for sections indicated by failure to progress and those by fetal distress.

Midwife and maternal satisfaction scores for epidural efficacy were available for 10 042 (75.5%) and 10 772 (80.9%) epidurals, respectively. Table 3 shows the number of failed

Table 1. BMI, age and proportion of primiparous women

	BMI group				*P* value
	<24.9 kg/m² (*n* = 3036)	**25–29.9 kg/m² (*n* = 5571)**	**30–39.9 kg/m² (*n* = 4238)**	**>40 kg/m² (*n* = 454)**	
Mean age in years (range)	27.5 (13–46)	28.1 (13–42)	28.5 (15–41)	27.8 (16–41)	<0.001 (*F* factor 26.62)
95% CI of mean	27.1–27.5	28.0–28.3	28.4–28.7	27.3–28.3	
Primiparous women, *n* (%)	2113 (69.6)	3656 (65.6)	2871 (67.7)	301 (66.3)	<0.75 (chi-trend statistic 1.79)

Table 2. BMI and operative deliveries

	BMI (kg/m^2)				*P* value (chi-trend statistic)
	<24.9 (*n* = 2854)	**25–29.9 (*n* = 5279)**	**30–39.9 (*n* = 3990)**	**>40 (*n* = 449)**	
Low forceps/ventouse, *n* (%)	645 (22.6)	1246 (24)	840 (21.1)	82 (18.3)	<0.1 (6.4)
Midcavity forceps, *n* (%)	173 (6.1)	301 (5.7)	233 (5.8)	25 (5.6)	<0.99 (0.2)
Caesarean section, *n* (%)	331 (11.5)	752 (14.3)	832 (20.1)	131 (29.2)	<0.001 (165.0)
For failure to progress	159 (5.6)	372 (7.1)	451 (11.3)	71 (15.8)	<0.001 (109.0)
For fetal compromise	145 (5.1)	338 (6.4)	329 (8.3)	51 (11.4)	<0.001 (40.3)

epidurals (rated as poor or useless) as judged by midwives and patients in the four BMI groups. It can be seen that there is a significant increase in failed epidurals (as judged by midwives) as BMI rises. Despite an obvious trend in maternal satisfaction scores in the same direction, this did not reach statistical significance. However, if the BMI groups <24.9 kg/m^2 and 25–29.9 kg/m^2 are combined, significance is clear (chi-trend statistic 13.5, $P < 0.01$).

Procedural data for the epidurals revealed several expected markers of increasing technical difficulty related to increasing BMI. These included the depth of the epidural space and number of women requiring extra long epidural needles. Of more importance, Table 3 shows a significant trend for the need for replacing failing epidurals as BMI increased.

Discussion

Before discussing these results, some aspects of the methodology require some consideration and criticism.

The fact that some of the BMI figures were calculated from estimated weight and height clearly weakens these data. However, our results show consistent trends for the effects of increasing obesity throughout our large data set, so it is unlikely that estimations at the extremes of the BMI range were seriously misplaced.

The BMI bandings used in this audit are those used by the WHO to define under nourishment and obesity. These bandings were not constructed with term pregnant women in mind, and to our knowledge, no internationally agreed norms have been described. In the context of the city of Leeds, a BMI of up to 30 kg/m^2 in a term pregnant women *looks* healthy and normal to the authors. Indeed, our pilot analysis used three BMI groups of up to 30 kg/m^2, 30–40 kg/m^2, and more than 40 kg/m^2, as this seemed to represent 'normal', 'overweight', and 'obese' in our view. The only change in the statistics seen by using the WHO classification was the loss of statistical significance in the patient satisfaction scores.

Our results show that obesity and morbid obesity increase the chances of analgesic failure by epidurals, as shown by resite rates, midwife satisfaction with epidural performance, and probably by patient satisfaction. There is also a clear association between obesity and the need for emergency caesarean section among women choosing epidural analgesia. It has been previously suggested that cephalopelvic disproportion and failure to progress were responsible for the higher caesarean section rate in obese women.[3] Our results show, at least in the context of women using epidural analgesia, that fetal distress is equally responsible. However, it should be noted that there is a shortfall between the sum of caesarean sections for fetal distress plus failure to progress and the total number of sections. This is due to the data processor not selecting a choice from the indication list in some cases.

It is already known that obesity increases the incidence of caesarean section. Does epidural analgesia further increase this incidence in obese women? Unfortunately, we cannot answer this question because we do not have matching data

Table 3. BMI and epidural outcomes

	BMI (kg/m^2)				*P* value (chi-trend statistic)
	<24.9, *n* (N) (%)	**25–29.9, *n* (N) (%)**	**30–39.9, *n* (N) (%)**	**>40, *n* (N) (%)**	
Midwife assessment					
Unsatisfactory epidural analgesia	119 (2318) (5.1%)	237 (4143) (5.7%)	249 (3240) (7.7%)	40 (341) (11.7%)	<0.001 (28.6)
Maternal assessment					
Unsatisfactory epidural analgesia	95 (2493) (3.8%)	148 (4340) (3.4%)	156 (3566) (4.4%)	26 (373) (6.9%)	<0.1 (6.2)
Resites	74 (3036) (2.4%)	136 (5571) (2.4%)	125 (4238) (2.9%)	30 (454) (6.6%)	<0.01 (12.06)

from women who did not receive epidural analgesia. Comparisons with other studies are hampered by the fact that epidural recipients are not differentiated from other women within their study groups.[9,10] It is tempting to assume a certain epidural rate within these studies of perhaps 30%, compare their results with our 100% epidural rate population, and ascribe any difference to the influence of epidural analgesia on obstetric outcome. Such a comparison would obviously carry little weight and would be further weakened by the dangerous assumption that the epidural rate is the same in all BMI groups. However, the order of magnitude of the increase in caesarean sections associated with BMI in our study is similar to that found in other studies. It should also be noted that all the epidurals given in this study were of the low-dose, high mobility variety, associated with better obstetric outcomes than older high-dose techniques. In summarising this particular point, this study cannot be used to differentiate the influences of obesity and epidural analgesia on mode of delivery, but it is our opinion that obesity has much more influence than low-dose epidural analgesia in increasing caesarean section rates.

Given the inherent weaknesses, how can the data produced by this study be used? It is routine practice for anaesthetists to warn women of the failure rate for epidural analgesia, usually quoting a figure from their unit's entire epidural data set. We suggest that this warning should be modified according to the BMI of the woman, pointing out an increased risk of analgesic failure and technical difficulties to obese and morbidly obese women. Although obstetricians and midwives should be aware of the high incidence of caesarean section among obese women receiving epidural analgesia, it is not immediately obvious how these data might help improve patient care if it is only considered during labour. Much more obvious, but also potentially delicate, is the value of these data during antenatal assessment. It is clear that if overweight women allow themselves to become obese through excessive weight gain during pregnancy, they increase their chances of requiring surgical intervention during labour and hence their exposure to risk. We suggest that this should be pointed out to overweight and obese women during the antenatal period and used to encourage sensible weight control during pregnancy. Ideally, women found to be overweight or obese at antenatal booking should be offered a weight management program. However, in the authors' experience, antenatal obesity is usually politely ignored for fear of causing offence. Perhaps this should change.

Conclusions

Obesity is a cause of technical difficulties and reduced efficacy with epidural analgesia during labour. Obesity has a marked impact on the mode of delivery of women receiving epidural analgesia, increasing the caesarean section rate as BMI rises. This information should be made available to overweight women in the antenatal period and added to the many other reasons to avoid excessive weight gain during pregnancy. ■

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