

## ORIGINAL ARTICLE

# Complications of obstetric epidural analgesia and anaesthesia: a prospective analysis of 10 995 cases

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**SUMMARY.** Although epidural anaesthesia and analgesia are widely used in obstetrics, there are no large contemporary prospective series detailing associated complications. Prospective data was collected on all obstetric epidural blocks performed for labour and delivery in a single institution between July 1989 and August 1994. A data entry sheet was compiled and entered onto a computer database. Confidence intervals for proportions were calculated using standard methods.

Information from 10 995 epidural blocks was analysed. Epidural analgesia in labour was the primary indication in 7648, and anaesthesia for caesarean section in 3311. Minor complications included failed or abandoned insertion (incidence 0.5%), reinsertion of the epidural catheter (5%), and inadequate anaesthesia (1.7%) or analgesia (0.9%). Three percent were associated with venous puncture and 0.6% with accidental dural puncture.

Maternal mortality was zero. Unexpectedly high blocks occurred on eight occasions (0.07%), two requiring intubation and ventilation. Three women (0.06%) experienced mild respiratory depression after postoperative epidural opioid. There was no major local anaesthetic toxicity or neurological deficit. The incidence of potentially life-threatening morbidity was thus 0.02%, although in both cases outcome was good. The only persisting complication was neurological, an apparent epidural catheter-induced traumatic mononeuropathy.

## INTRODUCTION

Advances in obstetric epidural management include the use of new analgesic solutions and methods of administration, alterations designed to minimize unwanted effects and improve safety, and improvements in equipment quality, training and supervision. Although the safety record of obstetric epidural techniques is excellent,<sup>1,2</sup> vocal minority groups frequently decry their use, partly based on a perception reinforced by unbalanced media coverage, that the risks are unacceptable.

It is unclear if an apparent increase in reporting of various complications reflects an actual increased incidence, increased use of epidural techniques, or the proliferation of medical publication. Accurate maternal mortality data are not available in many Western countries, and, in any case, represent only the tip of the iceberg for serious adverse events secondary to regional techniques.

Despite an increasing obligation to provide detailed and up-to-date information about the potential complications of epidural techniques, most relevant publications are 10–30 years old. The aim of this prospective study was to determine the minor and major complication rates of obstetric epidural analgesia and anaesthesia, as practised in a tertiary-referral obstetric unit consistently managing between 4600 and 5100 deliveries per year.

## METHODS

In 1989 an obstetric epidural database was established for all epidural blocks performed for labour and delivery, but not including those initiated ante- or postpartum. Information was collected on a purpose-designed data sheet (copy available from first-named author) following postpartum review of the patient and relevant components of the hospital medical record, and transcribed onto a computer database (Dbase IV). Initial data were collected within 48 h postpartum by three full-time anaesthetists and further information added, if necessary, subsequently. Confirmation of accuracy of the number of epidural

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blocks detailed was made by cross-checking against the hospital delivery register, and by checking the database for duplication. Accuracy within each data set was confirmed by intermittent comparison with random samples of medical records.

Data analysed in this study represent those from blocks performed between July 1989 and August 1994 (after which the information collected was modified). These blocks were conducted and managed, according to individual preference, by specialist and training anaesthetists, assisted by delivery unit and postnatal midwifery staff. The patient population consisted of approximately equal numbers of low- and high-risk parturients.

During the study period, the epidural analgesia rate during labour was 33–36% and the caesarean rate 18–23% (83–88% conducted under epidural anaesthesia). Epidural analgesia was provided on request, and to manage various medical and obstetric conditions. It was not routine practice to administer a test-dose for intravascular placement. Analgesia was usually established with 0.125% bupivacaine plus fentanyl, or 0.25% bupivacaine, and maintained by midwife-administered intermittent boluses, although patient-controlled and infusion analgesia were also used. Popular solutions for epidural anaesthesia were 0.5% bupivacaine and 2% lignocaine with adrenaline, both with added fentanyl. Postoperatively, epidural opioid analgesia was continued routinely.

Hypotension was defined as a fall in systolic blood pressure of > 30% and inadequate block as one failing to provide satisfactory analgesia or anaesthesia, despite adjustment of epidural solution or catheter manipulation. Inadequate anaesthesia for caesarean section was managed by intravenous opioid, ketamine or conversion to spinal or general anaesthesia. Subdural block was diagnosed clinically on the basis of slow onset of asymmetric sensory change with prominent cephalad extension and sacral sparing, and variable motor and haemodynamic change. Subarachnoid block was diagnosed on the basis of positive aspiration of cerebrospinal fluid and/or rapid onset of dense sensory and motor block with involvement of sacral nerves. Respiratory depression was identified by nursing observation of sedation and respiration.

95% confidence intervals (CI) for proportions were calculated using standard methods. Specific adverse events identified on the database (e.g. 'unexpected high block' or 'intravascular injection of local anaesthetic') were evaluated by the first author, by examining the hospital medical record, in an attempt to reach a conclusion regarding the mechanism involved or to review outcome.

## RESULTS

The database included 10 995 epidural blocks, although where information was missing or incomplete, proportions were calculated based on the number of complete data sets for that field. In all cases this was more than 97% of the total number of epidural blocks. Results are presented as both overall complication rates and rates based on known denominator subsets (for example, epidural blocks used only for labour analgesia; caudal vs lumbar epidural approach; or specialist vs trainee anaesthetist).

Parturients had a mean age of 28 years (range 12–46), weight 77 kg (range 42–164) and were of mixed parity (55% nulliparous). Catheters were inserted a mean distance of 4.5 cm into the epidural space. Epidural blocks were instituted primarily for labour management, elective, or unplanned caesarean delivery (see Table 1). Demographic data are shown in Table 2 and technical complications in Table 3. Trainees were

**Table 1. Epidural setting and outcome**

	<i>n</i>	%
Primary reason for inserting epidural ( <i>n</i> =10 959)		
Labour analgesia	7648	70
Elective caesarean	2071	19
Unplanned caesarean	1240	11
Epidural anaesthesia for caesarean	4624	42
Outcome of labour epidural analgesia ( <i>n</i> =7648)		
Vaginal delivery	6335	83
Caesarean	1313	17

**Table 2. Anaesthetist and epidural technique**

	<i>n</i>	%
Anaesthetist ( <i>n</i> =10 988)		
Specialist	3413	32
Trainee	7575	68
Epidural level* ( <i>n</i> =10 995)		
Thoracic	177	1.5
Lumbar	10 845	99
Caudal	575	5
Patient position ( <i>n</i> =10 751)		
Sitting	5415	50
Lateral	5336	50

\*Numbers and percentage exceed 100 because two levels were used in some cases.

**Table 3. Technical complications**

<i>n</i> =10 995	<i>n</i>	Rate	% (95% CI)
Failure to insert	61	1 in 180	0.6 (0.4–0.7)
Difficult to insert	920	1 in 12	8.4 (7.9–8.9)
Venous puncture	346	1 in 30	3.2 (2.8–3.5)
Dural puncture	69	1 in 160	0.6 (0.5–0.8)
Catheter damage	0	0	0 (0–0.03)
Difficult to remove	2	1 in 5500	0.02 (0–0.04)

**Table 4. Epidural management problems**

	<i>n</i>	Rate	% (95% CI)
Epidural catheter reinsertion ( <i>n</i> =10 995)	521	1 in 21	4.7 (4.3–5.1)
Hypotension after			
Epidural analgesia for labour ( <i>n</i> =6335)	311	1 in 20	4.9 (4.4–5.4)
Epidural anaesthesia at elective caesarean ( <i>n</i> =2071)	584	1 in 3.5	28 (26–31)
Inadequate block:			
Labour epidural analgesia only ( <i>n</i> =6335)	55	1 in 115	0.9 (0.6–1.1)
Epidural anaesthesia for caesarean ( <i>n</i> =4624)	78	1 in 60	1.7 (1.3–2.1)
Epidural anaesthesia for caesarean ( <i>n</i> =4624)			
Converted to GA intraoperatively*	31	1 in 150	0.7 (0.4–0.9)
Converted to GA because inadequate	23	1 in 200	0.5 (0.3–0.7)

\* Epidural anaesthesia converted to general anaesthesia because of pain, maternal anxiety, conversion to caesarean hysterectomy, etc.

**Table 5. Potentially serious epidural complications**

	<i>n</i>	Rate	% (95% CI)
Unexpected high block ( <i>n</i> =10 995)	8	1 in 1400	0.07 (0.02–0.1)
Requiring intubation	2	1 in 5500	0.02 (0–0.04)
Local anaesthetic toxicity ( <i>n</i> =10 995)			
Minor central nervous system	4	1 in 2800	0.04 (0–0.07)
Convulsions	0	0	0 (0–0.03)
Traumatic mononeuropathy ( <i>n</i> =10995)	1	1 in 11 000	0.01 (0–0.03)
Respiratory depression			
Postoperative or postdelivery epidural opioid ( <i>n</i> =4719)	3	1 in 1600	0.06 (0–0.13)
Post-morphine ( <i>n</i> =608)	2	1 in 300	0.3 (0.04–1.2)
Post-pethidine ( <i>n</i> =3957)	1	1 in 4000	0.03 (0.01–0.14)

three times more likely to fail in insertion and twice as likely to puncture the dura accidentally.

Several management problems are described in Table 4. Compared to specialists, epidural catheters placed by trainees were three times as likely to require intraoperative conversion to general anaesthesia.

Unilateral or asymmetric blocks, remediable only by catheter reinsertion, occurred in 145 cases (1 in 75 or 1.3%, CI 1.1–1.5%). There was clinical or radiological evidence of subdural block in 8 cases (1 in 1400 or 0.07%, CI 0.02–0.1%) and subarachnoid block in 10 cases (1 in 1100 or 0.09%, CI 0.03–0.15%). Eight women developed symptoms of dyspnoea following cephalad extension of block and two required intubation (Table 5). In one patient the injection of a dilute solution of bupivacaine and morphine at the completion of an otherwise uneventful epidural caesarean section was followed over 15 min by progressive dyspnoea, drowsiness and coma, suggesting a possible multicompartment block. Intubation and ventilation were required for one and a half hours. The second patient was given 20 ml of 0.5% bupivacaine for an elective epidural caesarean section and over the next 30 min developed an asymmetric sensory block extending to involve the trigeminal nerve, accompanied by drowsiness and then coma. Ventilation was required for 90 min and the catheter was subsequently shown radiologically to lie subdurally.

Symptoms and signs of central nervous system local anaesthetic toxicity (tinnitus, visual disturbance, slurred speech, altered conscious state) were noted in 4 cases (Table 5). Three followed injection via a lumbar approach (1 in 3500 or 0.03%, CI 0–0.06%) and one a caudal (1 in 600 or 0.17%, CI 0.01–1%). In one case blood was aspirated from the catheter, aspiration having initially been negative. Local anaesthetic doses producing toxicity were bupivacaine 35 mg over 3 min, lignocaine with adrenaline 280 mg over 5 min, and a mixture of plain bupivacaine 250 mg and lignocaine 150 mg over 1 h (lumbar catheters). A single-shot caudal epidural injection of 100 mg of plain bupivacaine over 2 min through a sharp-bevelled needle resulted in transient drowsiness and twitching, necessitating treatment with oxygen and diazepam. There were no convulsions or cardiotoxicity.

There were no cases of epidural opioid-induced respiratory depression during labour, preoperatively or intraoperatively. No cases involved epidural fentanyl (0 in 9447, incidence 0%, CI 0–0.03%). Three women having post-caesarean analgesia developed excessive sedation or respiratory rate below eight breaths per min (Table 5). Ten h after the last of three morphine doses (total 14 mg over 29 h), the first patient became somnolent and had a respiratory rate of 8 per min. She was given oxygen, and monitored with pulse oximetry, until improvement. The second

patient complained of drowsiness, difficulty with breathing (respiratory rate 12 per min), nausea and pruritus about 10 h after two morphine doses (total 9 mg over 20 h) and improved symptomatically after treatment with naloxone. A patient who received 100 mg of epidural pethidine (two 50 mg doses over 9 h) was found to be drowsy and disorientated, with a respiratory rate of 16 per min and diastolic blood pressure of 120 mm Hg. She was taking medication with depressant central nervous system activity (methyldopa and phenytoin). Her clinical condition improved following treatment with diazoxide and naloxone. There were no cases of cyanosis, apnoea or coma.

One case of apparent epidural catheter-induced traumatic mononeuropathy was identified. This patient demonstrated post partum L3 sensory loss following severe paraesthesia in the same dermatomal distribution during insertion of an epidural catheter. No resolution had occurred by discharge on the ninth postpartum day, and she failed to attend for subsequent evaluation. There were no major neurological complications (for example spinal canal haematoma or abscess, or cord injury) or cardiac arrests.

The incidence of potentially life-threatening complications (two high blocks requiring intubation and ventilation) was 1 in 5500 or 0.02%, CI 0–0.04%. The mortality was zero (95% CI 0–0.03%).

## DISCUSSION

The introduction of computerized data collection, quality improvement and collaborative multicentre studies is likely to improve the quality and detail of information about complications after obstetric epidural analgesia and anaesthesia. We have identified the incidence of complications in a single tertiary referral obstetric unit and teaching hospital anaesthetic department over a recent 5-year period.

### Technical complications

The incidence of insertion difficulties and the reinsertion rate (due to both clinical inadequacy and dislodgement) compared favourably with other series. For example, failed or abandoned insertion was at the lower end of the reported range of 0.2–0.7%,<sup>3–7</sup> fewer catheters were replaced,<sup>6,8</sup> and failure to achieve a satisfactory block was below the 2–5% previously reported.<sup>9–11</sup> As previously noted,<sup>3,4</sup> technical failures varied with the experience of the operator. Although reinsertion rate may reflect a different threshold for intervention, it is useful information which can be provided when obtaining consent.

Catheter damage was an important event in Crawford's 1985 series,<sup>12</sup> with 12 cases in 26 490 (1 in 2 200). In obstetric anaesthesia claims related to equipment, severance of an epidural catheter was responsible for five of eleven cases of medical litigation.<sup>13</sup>

Improved epidural catheter strength and greater awareness of this potential risk may account for the absence of this complication in this series.

The flexed lateral position has been recommended when removing epidural catheters.<sup>14</sup> In one case of difficulty we encountered, the catheter was left in situ overnight after delivery, and then withdrew easily. In the other, similar to a previous report,<sup>15</sup> post-operative removal proved impossible until the patient assumed an erect, hyperextended posture. A 3% incidence of venous puncture was similar to other obstetric series,<sup>4–7</sup> although prospective trials report 6–16%, with reduction by the prior injection of 5–10 ml of fluid or the use of 18 gauge epidural needles.<sup>15–17</sup>

An incidence of 1 in 100 has been suggested as an unacceptable rate of inadvertent dural puncture.<sup>19</sup> Our higher rate among trainees supports studies in which 79% of all dural taps were done by anaesthetists who had performed less than 100 labour epidurals,<sup>20</sup> and in which previous experience was inversely related to dural puncture rate.<sup>21</sup> Our overall rate compares favourably with other obstetric teaching hospitals,<sup>6–8,10, 20–23</sup> being less than a sixth of one US centre,<sup>24</sup> which is probably explained by greater prior experience of our trainees with epidural blocks before secondment to our Department.

### Management problems

Hypotensive episodes associated with epidural analgesia during labour are infrequent if large bolus doses of local anaesthetic and aortic caval compression are avoided. Our incidence of 5% is similar to a recent study in which intravenous pre-loading was used.<sup>25</sup> The value of intravenous fluid hydration in this setting is based on a single poorly designed study, is controversial<sup>26</sup> and remains inadequately investigated. In contrast, hypotension is common when initiating epidural anaesthesia for caesarean section and various management strategies are possible.<sup>27</sup>

No previous series have quantified the intraoperative failure of regional techniques during caesarean section. We found that 1 in 200 apparently satisfactory blocks subsequently required conversion to general anaesthesia intraoperatively because of pain. Litigation because of unexpected pain during awake anaesthesia is increasing, emphasizing the importance of warning patients of (and preferably quantifying) the risk of both mild and severe pain.

### Problems with epidural block

Persistent unilateral or asymmetric block occurs for several reasons, most commonly transforaminal escape of the catheter or midline diffusion barriers within the epidural space.<sup>28</sup> Our incidence of persisting unilateral sensory block (1 in 80) is similar to that in two large US units.<sup>8,9</sup> Inadvertent subarachnoid block, especially total spinal anaesthesia, is a potentially serious event. Three deaths have occurred since 1984 in the United Kingdom, although there were no cases in the last two triennial reports. Although likely to be underestimations, two large surveys from the UK and France found a rate of total spinal anaesthesia of 1 in 63 000<sup>29</sup> and 1 in 8000<sup>30</sup> respectively, and older studies between 1 in 900 (performed by obstetricians<sup>31</sup>) and 1 in 4400.<sup>12,23,32</sup> These contrast with a lower incidence from more recent data of 1 in 10 000<sup>7</sup> to zero in almost 15 000.<sup>33</sup> Despite no total spinal blocks in this series, we previously reported a case which occurred about a year prior to commencing the database.<sup>34</sup> Furthermore, six unexpectedly high blocks (three of which were probably subarachnoid) resulted in dyspnoea requiring observation. Two further parturients required intubation and ventilation. While lower than that of Dawkin's 1969 review of the literature,<sup>4</sup> this incidence of symptomatic high block (1 in 1400) and potentially life-threatening high block (1 in 5500) is similar to a recent 2-year multicentre prospective series of epidural and spinal obstetric blocks.<sup>35</sup> Both our cases requiring intervention appeared to involve subdural injection, and were clinically similar to a report of intracranial spread of large volumes of subdural local anaesthetic.<sup>36</sup> The incidence of subdural block in obstetrics is unknown, and our incidence of 1 in 1400 may be an underestimate, since an incidence of almost 1% (based on clinical diagnosis) was reported after lumbar epidural analgesia in a pain centre.<sup>37</sup>

### Neurological complications

Neurological complications related to pregnancy are more common than generally appreciated. Transient post partum sensory neurological dysfunction can be elicited in 21% of women<sup>38</sup> and at the turn of the century, femoral neuropathy alone complicated more than 3% of deliveries.<sup>39</sup> Modern data suggest clinically important transient paraesthesias or motor dysfunction occur in 1 in 500<sup>40</sup> and prolonged deficits 1 in 2500.<sup>41</sup> The incidence in parturients having regional techniques during pregnancy appears similar. Youngstrom et al<sup>7</sup> reported 1 in 1000 temporary neurological sequelae and Scott and Tunstall<sup>35</sup> 1 in 2700 mononeuropathies.

Although causation may be difficult to establish, transient radiculopathies can follow epidural insertion and may be equipment-related.<sup>42</sup> However, many obstetric staff fail to appreciate that post-partum neurological dysfunction is more likely to result from obstetric or surgical palsy, or peripheral nerve compression injury, than from epidural-induced trauma. Holdcroft et al<sup>41</sup> identified 1 in 13 000 patients with persistent traumatic mononeuropathy contributed to by epidural technique, a ratio of 1 in 6 compared with obstetric palsy. We believe our similar incidence is accurate, because all neurological deficits noted in the postpartum period are referred to our department for assessment.

Cord or nerve root injury associated with epidural block is uncommon, being reported 1 in 1200–11 000 surgical patients prior to 1975.<sup>3, 43</sup> A Swedish general hospital recently reported 1 in 1000 persisting neurological lesions in association with epidural anaesthesia.<sup>44</sup> Of these, three were paraplegias where the epidural technique was the likely cause (incidence 1 in 3100). One might expect an obstetric population to have a lower incidence, and, indeed, epidural haematoma, abscess or paraplegia are exceptionally rare events in pregnancy and the puerperium.<sup>45,46</sup>

### Local anaesthetic toxicity

Many years ago, convulsions due to local anaesthetic toxicity occurred in 1 of 500–1500 patients.<sup>4,23,32,47</sup> More recently, this had fallen to 1 in 5000<sup>7</sup>–9000,<sup>12</sup> and in a recent general teaching hospital series was 2 in 16 870 (1 in 8400, 95% CI 1 in 2500–100 000).<sup>48</sup> Although infrequent, local anaesthetic toxicity remains a serious complication, and was a major cause of anaesthetic-related maternal mortality in North America and Australia during the 1980s. Bupivacaine toxicity after caudal administration resulted in a maternal death in Australia as recently as 1992.<sup>49</sup> In general surgical populations, the risk of convulsion after caudal anaesthesia is 1 in 80–330.<sup>48,50</sup> Our incidence (1 in 550) also suggests this approach confers a higher risk of toxicity compared to a lumbar approach, possibly partly due to a greater chance of intravenous or intraosseous injection.

### Opioid-induced respiratory depression

This series supports the safety of epidural opioid (predominantly fentanyl) administered during labour. The three cases of early postoperative respiratory depression did not cause serious concern, and naloxone produced a prompt and sustained improvement. Two women had received repeat boluses of epidural morphine, giving an incidence for this opioid of 1 in 300.

This is consistent with a retrospective review<sup>51</sup> of single-dose administration after caesarean section and emphasizes the importance of regular monitoring. The case involving epidural pethidine was confounded by other potentially contributory factors. Post-caesarean epidural pethidine has an exceptionally good safety record with respect to the risk of respiratory depression.<sup>52</sup>

### Conclusion

Epidural anaesthesia is now a rare cause of maternal mortality, resulting in one direct death in each of the last three Confidential Enquiries into Maternal Deaths in the UK. Serious morbidity is undoubtedly more frequent and may lead to litigation. The American Society of Anesthesiologists closed claims database analysis detailed five cases of paraplegia between 1975 and 1989<sup>53</sup> and several cases of major local anaesthetic toxicity or complication after total spinal block.<sup>13</sup>

This prospective series indicates that it is possible to provide an effective obstetric epidural service with few serious complications. Immediate intervention prevented permanent harm in two cases. The incidence of each of the four major complications of epidural block (local anaesthetic toxicity, high block requiring intervention, severe opioid-induced respiratory depression and neurological deficit) was lower than, or at worst comparable to, previous series. It would appear that well-managed contemporary obstetric epidural analgesia and anaesthesia are now safer than in the past.

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