British Journal of Anaesthesia **84 (6)**: 725–30 (2000)

Caesarean section for placenta praevia: a retrospective study of anaesthetic management

N. Parekh[1], S. W. U. Husaini[2] and I. F. Russell[3]*

[1]Department of Anaesthesia, St James' University Hospital, Beckett Street, Leeds LS9 7TF, UK. [2]Department of Anaesthesia, Bradford Royal Infirmary, Bradford BD9 6RJ, UK. [3]Department of Anaesthesia, Hull Royal Infirmary, Kingston upon Hull HU3 2JZ, UK

**Corresponding author*

A retrospective survey of anaesthesia for Caesarean section (CS) for placenta praevia was performed, covering the period between January 1, 1984 and December 31, 1998. Three hundred and fifty consecutive cases of placenta praevia were identified. Overall a regional technique was used 60% of the time. Five women had a placenta accreta which required Caesarean hysterectomy: one had general anaesthesia (GA) throughout and four initially received a single-shot spinal injection. Of these latter four cases, two were converted to GA during the hysterectomy and two continued with spinal anaesthesia throughout. Two other women (both GA), suffered postoperative thrombotic episodes (one pulmonary embolus and one cerebral thrombosis) but made full recoveries. Control of blood pressure when using regional anaesthesia (RA), even in the presence of considerable haemorrhage, was not a problem. Statistical regression models indicated that RA was associated with a significantly reduced estimated blood loss and reduced need for blood transfusion. This retrospective survey finds no data to support the much quoted aphorism that RA is contraindicated for CS in the presence of placenta praevia.

Br J Anaesth 2000; **84**: 725–30

Keywords: anaesthesia, obstetric; anaesthetic techniques, regional

Accepted for publication: January 13, 2000

Placenta praevia occurs when part of the placenta implants within the lower uterine segment. It complicates 4.8 per 1000 deliveries and is fatal in 0.03% of these.[1] It is one of the major causes of massive obstetric haemorrhage and can result in increased maternal, fetal and neonatal morbidity or mortality. In the three UK triennial maternal mortality reports from 1988 to 1996, a total of 12 maternal deaths were direct results of haemorrhage from placenta praevia.[2–4]

Anaesthesia for Caesarean section (CS) for placenta praevia is controversial. While many anaesthetists believe that general anaesthesia (GA) is mandatory for CS for placenta praevia, there is recent evidence that views may be changing.[5–8] Surveys[6–8] demonstrate a wide variation in practice among obstetric anaesthetists, with the majority (>80%) now willing to consider using regional anaesthesia (RA) for placenta praevia depending on the position of the placenta, the urgency of the situation and the extent of any continuing antenatal blood loss.[6–8] However, many respondents expressed a desire for advice on the anaesthetic management of placenta praevia.[6] Apart from anecdotal opinion,[5–10] there is little evidence on which to base such advice. Arcario and colleagues,[11] in a retrospective review of 180 patients, confirmed that RA was not necessarily contraindicated in this patient population and felt that RA techniques may decrease the estimated blood loss. In a study of maternal and perinatal morbidity resulting from 147 cases of placenta praevia, RA was used in 25% of cases with no maternal morbidity attributable to the anaesthetic techniques used.[12]

Before the widespread introduction of muscle relaxants into anaesthetic practice, placenta praevia was not viewed as a contraindication to RA. Indeed, spinal anaesthesia was viewed by some as the ideal anaesthetic. Compared with the then available GA techniques, spinal anaesthesia allowed easier intra-pelvic manipulations and uterine atony was unusual. In consequence of this latter fact, there was significantly less haemorrhage from the placental site and obstetric shock was rare with spinal anaesthesia.[13–15] However, in the 1940s the safety of spinal anaesthesia was called into question because of fears of neurological dam-

age[16 17] and its practice in Britain virtually stopped. Around this same time muscle relaxants were introduced into anaesthetic practice. Obstetric anaesthesia based on muscle relaxants and light GA avoided most of the disadvantages of the previous spontaneously breathing inhalational GA techniques and became widely used. Subsequently, British obstetric anaesthetists had little training in, or expertise, with RA for many years, and GA became the norm for most CSs.

In recent years there has, once again, been a swing to RA for CS, with 78% of all sections now being performed under RA and, in some units, well over 90%.[18] With the paucity of published evidence available on which to base any objective recommendation, the authors' two maternity hospitals have had no firm policy on anaesthesia for placenta praevia, the technique being left to the discretion of individual anaesthetists. When this survey was initiated, about half the cases were conducted under RA. With such an even split it was felt that a retrospective analysis of our cases may provide useful information on which to base future recommendations.

Methods

In the absence of a hospital computerized obstetric database, both the hand-written labour ward register and the obstetric operating theatre register were examined and all cases where either placenta praevia or antepartum haemorrhage (APH) was recorded as a reason for CS were identified. The obstetric notes were obtained for all these patients and the cases of placenta praevia identified. The period covered by the survey was from January 1, 1984 to December 31, 1998. For each patient, the following information was recorded: gestation, parity, number of previous CSs, grade of placenta praevia, position of placenta (from ultrasound scan reports or description at surgery), the nature of the surgery (emergency or elective, as defined by the obstetrician), the anaesthetic technique used, the grade of the most senior anaesthetist present, estimated blood loss during surgery, preoperative haemoglobin (Hb) (within 24 h if there was a history of persistent vaginal bleeding), postoperative Hb (second or third postoperative day), and problems or comments noted by the anaesthetist. To compensate for blood transfused before the second venous Hb sample was obtained, the reported postoperative Hb concentrations were reduced by 1 g dl^{-1} for every unit of blood transfused.

These data were entered into a spreadsheet (Microsoft Excel v.4 for Windows NT 4.0) and analysed using SPSS (7.5.1) for Windows NT (4.0) and Genstat (v.5, release 4.1), the latter run on a mainframe computer under Unix. Depending on the data, parametric and nonparametric tests were used. The difference between preoperative and postoperative Hb was analysed using multiple regression with backward elimination of factors to select the final model (Genstat). Because of the known inaccuracies of estimating blood loss, the estimated volumes were grouped into the following categories: $\leqslant$500, 501–1000, 1001–1500, 1501–2000 and $\geqslant$2000 ml. There were only seven patients in the $\geqslant$2000 ml group, too few for statistics to be meaningful, these seven patients were amalgamated with the 1501–2000 ml group and the data were analysed using proportional-odds ordinal regression, again with backward elimination to select the final model (Genstat). Transfusion requirements were analysed using a Poisson regression model with backward elimination of factors to select the final model (Genstat). $P<0.05$ was taken as indicating statistical significance.

Table 1 The grade of placenta praevia, the nature of surgery and the anaesthetic technique used. El=elective Caesarean section. Em=emergency Caesarean section; GA=general anaesthesia; RA=regional anaesthesia; RA%=regional anaesthesia as a percentage of the total number of anaesthetics. *Includes one case where spinal anaesthesia was performed but failed to spread adequately, so GA was given. **Includes one case of spinal anaesthesia for Caesarean section, GA for hysterectomy. ***Includes one case of spinal anaesthesia for Caesarean section and hysterectomy

	Grade 1		Grade 2		Grade 3		Grade 4		Total
	El	Em	El	Em	El	Em	El	Em	
GA	6	14	7	29*	13	43*	6	22	140
RA	20***	19	48**	20	44***	26	21**	12	210
RA%	77	58	87	41	77	38	78	35	60

Results

Three hundred and fifty consecutive cases of placenta praevia progressing to CS were identified from January 1, 1984 to December 31, 1998 inclusive. Table 1 shows the type of surgery and the grade of placenta praevia. Overall 210 CSs (60%) were performed with a RA technique. Table 2 shows the grade of the most senior anaesthetist present, the type of anaesthetic, conversions of one anaesthetic technique to another and the nature of the CS.

There were 140 women with an anterior placenta praevia; 31 of these had experienced a previous CS. Only two of the latter proceeded to hysterectomy (Table 3). In total, there were seven cases of placenta accreta of which five progressed to hysterectomy (Table 3). Two of these women had a spinal anaesthesia for their CS and GA for their hysterectomy because the spinal anaesthesia wore off as a result of delay in performing the hysterectomy. In the two remaining spinal anaesthesia cases there was no delay in proceeding to hysterectomy; in both cases the spinal anaesthesia provided anaesthesia sufficient for the total duration of the surgery.

As regards anaesthetic problems, in addition to the information in Table 2, there were four cases where it took 'multiple attempts' to place spinal anaesthesia successfully; one potentially difficult intubation was avoided by the use of an epidural; two women known to have had previous problems with suxamethonium (scoline apnoea; cardiac arrest following extreme bradycardia unresponsive to

Table 2 The grade of the most senior anaesthetist present and type of anaesthesia used for emergency or elective Caesarean section for placental praevia. GA= general anaesthesia. †Includes one failed spinal anaesthesia converted to GA before delivery. ‡Includes two spinal anaesthesias for Caesarean section with GA for hysterectomy, one failed epidural converted to spinal anaesthesia preoperatively and two spinal anaesthesias for Caesarean section and subsequent hysterectomy. ‡‡Includes one Caesarean section proceeding to hysterectomy. ††Includes one combined spinal–epidural anaesthetic. **Includes one combined spinal–epidural anaesthetic where the spinal component failed to spread and the epidural was topped up preoperatively

	Emergency Caesarean section			Elective Caesarean section			Total
	GA	Spinal	Epidural	GA	Spinal	Epidural	
Consultant	12	20	6	13‡‡	53‡	13**	117
Associate specialist	4†	2	0	2	10		18
Senior registrar	4	1		2	7		14
Staff anaesthetist	3	5	1	0	2	0	11
Registrar	55	19††	5	10	20	9	118
SHO/clinical assistant	35†	11††	2**	5	11	8	72
Total	113	58	14	32	103	30	350

Table 3 The seven cases of placenta accreta with their management. CS=Caesarean section; El=elective Caesarean section; Em=emergency Caesarean section; GA=general anaesthesia throughout; Sp=spinal anaesthesia throughout; Sp/GA=spinal for Caesarean section with GA for hysterectomy

Position of placenta	Previous CS	El/Em	Anaesthetic	Most senior anaesthetist present	Hysterectomy	Total units of blood transfused
Anterior	no	El	Sp	consultant	yes	4
Anterior	no	El	GA	consultant	no	4
Anterior	yes	El	Sp/GA	consultant	yes	28
Anterior	yes	El	GA	consultant	yes	5
Posterior	yes	El	Sp/GA	consultant	yes	3
Posterior	yes	El	Sp	consultant	yes	2
Anterior	no	Em	GA	staff doctor	no	2

atropine 1.2 mg) received spinal anaesthesia; one difficult intubation was encountered during induction of GA in an emergency case; there were two cases of oxygen desaturation during GA (one of these was eventually diagnosed as being caused by endobronchial intubation, while the other remained cyanosed throughout surgery despite various attempted remedies); one patient with known malignant hyperpyrexia received total intravenous anaesthesia. Two other GA cases had thrombotic episodes postoperatively. The first of these patients had GA for her CS where placenta accreta was encountered. Surgery proceeded directly to subtotal hysterectomy after delivery of the infant. Over a 24 h period, this patient received 6500 ml crystalloid, 2000 ml colloid and 5 units of blood. Her subsequent recovery was complicated by intermittent pyrexia, abdominal pain, chest tightness, dizziness and the development of a broad ligament haematoma. She was eventually discharged on day 14 but then on day 18 she was admitted as an emergency to the chest unit following a pulmonary embolus for which she was given anticoagulant. The second patient, with a grade IV placenta praevia, had an uneventful CS under GA and an uncomplicated postoperative period while in hospital. Then, on day 13, she awoke at home with a severe headache and a left hemiparesis. An MRI scan revealed an infarct caused by arterial thrombosis deep within the right hemisphere. Both women made full recoveries.

Hypotension was a specific problem recorded in 13 women undergoing RA: eight procedures were elective (five spinal anaesthetics, one combined spinal epidural (CSE), two epidurals) and five were emergency (three spinal anaesthetics, two CSE). In none of these cases was the hypotension related to blood loss. In 11 cases, hypotension occurred during the initial induction of the block. In the two remaining cases, hypotension occurred shortly after delivery and was associated with uterine manipulation. In neither case did it cause any concern. The average estimated blood loss during surgery in these 13 women was 600 ml (range 200–1500 ml). Only one of these women received a blood transfusion. Hypotension was a specific problem in seven GA patients (five emergency, two elective) and was always associated with intra-operative bleeding. The average estimated blood loss in this subgroup of seven women was 1600 ml (range 500–3500 ml). All but one of these women received a blood transfusion.

One hundred and eighty five cases (53%) were classified as either emergency or urgent and in the majority of these (69%) anaesthesia was performed by a registrar or SHO grade anaesthetist. There was a highly significant difference between the anaesthetic techniques used by consultants and trainees in emergency cases: trainees used GA 71% of the time, compared with 40% for consultants (chi-squared $P=0.0005$). With regard to the elective cases, although there was a similar trend with GA being used for 17 and 24% of cases by consultants and trainees, respectively, the difference was not statistically significant (chi-squared $P=0.25$).

Analysis of the haematological information was complicated by the fact that women received blood transfusions at various times, before during or after the operation. For 11 women who had received 5–28 units of blood it

Table 4 The estimates (i.e. beta values), with their standard errors, for the variables which were found to be statistically ($P<0.05$) associated with estimated blood loss (proportional odds ordinal regression modeling). Cut point 0/1, ⩽500 ml; cut point 1/2, ⩽1000 ml; cut point 2/3, ⩽1500 ml

	Estimate (SE)
Cut point	
0/1	8.31 (2.65)
1/2	10.29 (2.67)
2/3	11.26 (2.68)
Year	0.0936 (0.0293)
Regional anaesthesia	–0.082 (0.242)
Position of placenta	
Posterior	–0.570 (0.235)
Central	–0.259 (0.661)
Lateral	–0.212 (0.598)
Grade of placenta praevia	
II	0.09 (0.346)
III	0.312 (0.331)
IV	0.824 (0.401)

Table 5 The estimates (i.e. beta values), with their standard errors, for the variables which were found to be statistically ($P<0.05$) associated with blood transfusion requirements (Poisson regression modelling)

	Estimate (SE)
Constant	3.106 (0.729)
Gestation	–0.0826 (0.0208)
Regional anaesthesia	–1.074 (0.173)
Position of placenta	
Posterior	–0.446 (0.155)
Central	–0.706 (0.407)
Lateral	–1.129 (0.707)
Grade of placenta praevia	
II	–0.311 (0.231)
III	–0.340 (0.22)
IV	0.469 (0.219)

was not possible to ascertain when the preoperative and postoperative blood samples were obtained in relation to the blood transfusions they received. The data for these 11 women (7 emergency, 4 elective) were excluded in the analysis of differences between preoperative and postoperative Hb concentrations but included in all other analysis.

After all the data had been entered into the relevant stepwise regression procedures, the only variables that showed a statistically significant predictive relationship with estimated blood loss were the anaesthetic (GA or RA), the position of the placenta, the grade of the praevia and the year of surgery. For blood transfusion requirements, the significant variables were the anaesthetic (GA or RA), the position of the placenta, the grade of praevia and the gestation. These variables and the equations created by the regression statistics are shown in Tables 4 and 5. No statistically significant variables were associated with the difference between preoperative and postoperative Hb concentration.

Mean estimated blood loss (SD) for all patients in the study was 672 (441) ml; for RA patients only it was 613 (367) ml and for GA patients only it was 756 (518) ml (95% confidence interval for the difference between the means was 41–244 ml; $P=0.006$).

Discussion

Recent surveys have indicated, that while many anaesthetists are willing to use RA for CS for placenta praevia, others would not do so under any circumstances.[6–8] A desire has been expressed for advice on the anaesthetic management of placenta praevia[6] but there is a lack of published evidence on which to base any objective advice. Arcario and colleagues,[11] in a retrospective review of 180 patients, felt that RA was not necessarily contra-indicated in this patient population and that RA techniques may, in fact, decrease the estimated blood loss at surgery for simple placenta accreta. However, their study, which was presented in abstract only, provided few other details. McShane, Heyl and Epstein,[12] in a retrospective study of 147 cases of placenta praevia, reported briefly that RA had been used in 25% of cases and that there was no maternal morbidity attributable to the anaesthetic techniques used. Our current, more detailed, retrospective study of anaesthesia for 350 cases of placenta praevia provides further evidence to complement these two studies. We found no significant permanent morbidity associated with any of the anaesthetic techniques and, like Arcario and colleagues,[11] we noted a significantly lower estimated blood loss in the RA group. Unlike the two previous studies,[11 12] our data allowed us to apply regression statistics to control for the many interacting factors affecting blood loss. This process clearly indicated that, compared with GA, RA was associated with a significantly lower estimated blood loss and lower transfusion requirements, whatever the classification of the CS or the grade of placenta praevia.

It is accepted that estimating blood loss during CS is notoriously inaccurate and this was the reason for the broad groupings of estimated blood loss. Despite the inaccuracies, the estimates are probably a useful indicator of how concerned the anaesthetist or surgeon was during the procedure. At the same time it must be recognized that estimated blood loss and, hence, the need for blood transfusion may be biased by the beliefs of the anaesthetist or obstetrician. Those with confidence in RA may make lower estimates of blood loss which, in turn, may influence the blood transfusion rate. However, if patients were being systematically undertransfused in the RA group, this would be revealed in the postoperative Hb concentrations. There is no evidence from the data that the RA group were undertransfused since, compared with the GA group, the RA group had a similar mean preoperative Hb concentration, a lower rate of blood transfusion, a similar mean postoperative Hb concentration, and a similar preoperative–postoperative Hb difference.

While massive haemorrhage is a recognized complication of placenta praevia, there was no evidence from this survey to indicate that the management of such haemorrhage was

a problem under RA. Those who advocate GA for placenta praevia fear that the sympathetic blockade induced by RA will make it difficult or impossible to control arterial pressure should severe haemorrhage occur. In our survey, ephedrine was the only sympathomimetic drug required, except in one patient. While it is accepted that inducing RA in the presence of uncorrected hypovolaemia may be fraught with problems, the physiological responses to haemorrhage when haemorrhage first occurs after RA has been safely established is a very different scenario. In this latter situation, in contrast to GA, RA may provide a protective effect.[19 20] The normal intense vasoconstriction associated with significant blood loss is not possible with RA and the arterial pressure is much more dependent on intravascular fluid volume than during GA. During light GA, the brisk sympathetic reflexes may maintain arterial pressure in the face of significant continuing blood loss and lead the less experienced anaesthetists and surgeons to underestimate blood loss and undertransfuse until circulatory collapse suddenly occurs. The intense vasoconstriction during such light GA may also be detrimental to organ perfusion and oxygenation and may predispose the mother to major organ failure in the postoperative period. When dogs are bled after induction of high thoracic epidural anaesthesia, there is significantly better survival than if the animals are bled to a similar degree in the absence of epidural anaesthesia (9/10 compared with 2/10 survival, respectively).[19] The dogs in the thoracic epidural group had slower heart rates, greater cardiac stroke volume, higher arterial pH and bicarbonate concentration, and lower catecholamine and lactate concentrations than the GA controls.[19] Further evidence of some protection from the effects of haemorrhage by epidural anaesthesia can be found in sheep: epidural anaesthesia attenuated the increase in uterine vascular resistance associated with haemorrhage.[20]

Some may have anxieties regarding the management of heavy blood loss in conscious patients but this retrospective review did not highlight any concerns about anaesthesia. Seven women had an estimated blood loss of $>$35–40% of their estimated blood volume. Of these women, five had GA from the outset because of significant APH, so consciousness was not an issue; one primigravid patient with an anterior grade III placenta praevia received a spinal anaesthetic and subsequently lost an estimated 3000 ml of blood but, as this was replaced rapidly with warmed blood and other fluids, no untoward effects were observed. Only one mother had symptoms related to blood loss; this woman, with two previous CSs and a grade II anterior placenta praevia, had a spinal anaesthetic and lost an estimated 6000 ml over the 60 min duration of her CS.

Another possible area of concern in relation to RA, particularly spinal anaesthesia, is the duration of surgery. In our survey, technical problems aside, duration of an adequate block from either a spinal or epidural anaesthetic for CS for placenta praevia was not a problem.

In two prospective studies of anaesthesia for Caesarean hysterectomy, 24 of 60[21] and seven of 28[22] cases initially commenced under RA required conversion to GA. In the study by LaPlatney and O'Leary,[21] four of 18 spinal anaesthetics required 'inhalational supplementation' and two of these developed aspiration pneumonitis (from the data it is not clear if 'inhalational supplementation' is equivalent to intubation and formal GA or merely as it says, 'inhalational supplementation'). This led the authors to comment that GA should be considered preferable.[21] On the other hand Chestnut and Redick[22] felt that women should not be prohibited from choosing epidural anaesthesia for Caesarean hysterectomy and, in a prospective study of Caesarean hysterectomy, Chestnut and colleagues,[23] using RA in 13 of 45 cases, stated that they believed elective Caesarean hysterectomy was not a contraindication to epidural anaesthesia.

It is not clear why the year of surgery was positively correlated with an increased estimate of blood loss. This apparent correlation could have been caused by chance or the year may be a proxy indicator for some other factor (perhaps related to changes in medical staffing on the labour ward). Unfortunately, information on the duration of surgery and the grade of operator was not collected in our survey.

Whatever the anaesthetic technique, it is essential that plans are made to contend with sudden blood loss. If the mother is to be awake, then the possible need for rapid fluid or blood replacement should be explained preoperatively to reduce anxiety should the need for such infusions arise. In the absence of prospective randomized trials, it is difficult to find objective evidence on which to base the arguments for or against GA or RA for placenta praevia. However, this retrospective analysis of anaesthesia for placenta praevia finds no evidence to support the much quoted opinion that GA is mandatory in such cases. Indeed, to the contrary, this study adds to the growing literature[11 12 22 23] suggesting that, when RA is used, not only is there no reduction in maternal safety in relation to the management of blood loss but there may be a reduced blood loss and reduced need for postoperative blood transfusion.

References

1 Iyasu S, Saftlas AK, Rowley DL, Koonin LM, Lawson HW, Atrash HK. The epidemiology of placenta previa in the United States, 1979 through 1987. *Am J Obstet Gynecol* 1993; **168**: 1424–9

2 Department of Health, Welsh Office, Scottish Office Home and Health Department; Department of Health and Social Services, Northern Ireland. *Report on Confidential Enquiries into Maternal Deaths in the United Kingdom 1988–90*. London: HMSO, 1994

3 Department of Health, Welsh Office, Scottish Office Home and Health Department; Department of Health and Social Services, Northern Ireland. *Report on Confidential Enquiries into Maternal Deaths in the United Kingdom 1991–93*. London: HMSO, 1996

4 Department of Health, Welsh Office, Scottish Office Department of Health, Department of Health and Social Services Northern Ireland. *Why Mothers Die. Report on Confidential Enquiries into Maternal Deaths in the United Kingdom 1994–96*. London: The Stationery Office, 1998

5 Tunstall ME. Section 1. Discussion. In: Reynolds F, ed. *Epidural and Spinal Blockade in Obstetrics*. London: Bailière Tindall, 1990; 35–7

6 Bonner SM, Haynes SR, Ryall D. The anaesthetic management of Caesarean section for placenta praevia: a questionnaire survey. *Anaesthesia* 1995; **50**: 992–4

7 Peel WJ. A survey of the anaesthetic management of patients presenting for Caesarean section with 'high risk' obstetric conditions. *Int J Obstet Anaesth* 1996; **5**: 219–20

8 Plumer MH, Rottman R. How anesthesiologists practice obstetric anesthesia. Responses of practicing obstetric anesthesiologists at the 1993 meeting of the Society for Obstetric Anaesthesia and Perinatology. *Reg Anesth* 1996; **21**:49–60

9 Bromage PR. *Epidural Analgesia*. Philadelphia: WB Saunders, 1978.

10 Crawford JS. *Obstetric Analgesia and Anaesthesia.* Edinburgh: Churchill Livingstone, 1984; 109–10

11 Arcario T, Greene M, Ostheimer GW, Datta S, Naulty JS. Risks of placenta praevia/accreta in patients with previous Caesarean deliveries. *Anesthesiology* 1988; **69** (Suppl 3A): A659

12 McShane PM, Heyl PS, Epstein MF. Maternal and perinatal morbidity resulting from placenta praevia. *Obstet Gynecol* 1985; **65**: 176–82

13 Thomas RC. Caesarean section under spinal analgesia. *J Obst Gynaec Brit Emp* 1942; **49**: 247–74

14 Resnick L. Heavy nupercaine spinal analgesia in operative obstetrics. *Br Med J* 1945; **24**: 722–3

15 Thomas RC. Caesarean section under spinal analgesia. *J Obst Gynaec Brit Emp* 1944; **51**: 324–9

16 Kennedy F, Effron AS, Perry G. The grave spinal cord paralyses caused by spinal anaesthesia. *Surg Gynec Obstet* 1950; **91**: 385–98

17 Cope RW. The Wooley and Roe Case. Wooley and Roe versus the Ministry of Health and others. *Anaesthesia* 1954; **9**: 249–70

18 Shibli ?, Russell ? *authors to add details*

19 Shibata K, Yamamoto Y, Murakami S. Effects of epidural anesthesia on cardiovascular responses and survival in experimental hemorrhagic shock in dogs. *Anesthesiology* 1989; **71**: 953–9

20 Vincent RD, Chestnut DH, McGrath JM, Chatterjee P, Poduska DJ, Atkins BL. The effects of epidural anesthesia on uterine vascular resistance, plasma arginine vasopressin concentration, and plasma renin activity during hemorrhage in gravid ewes. *Anesth Analg* 1994; **78**: 293–300

21 La Platney DR, O'Leary JA. Anesthetic considerations in Cesarean hysterectomy. *Anesth Analg* 1970; **49**: 328–30

22 Chestnut DH, Redick LF. Continuous epidural anesthesia for elective Cesarean hysterectomy. *South Med J* 1985; **78**: 1168–9

23 Chestnut DH, Dewan DM, Redick LF, Caton D, Spielman FJ. Anesthetic management for obstetric hysterectomy: a multi-institutional study. *Anesthesiology* 1989; **70**: 607–10