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ORIGINAL RESEARCH

A retrospective audit of anaesthesia for caesarean section in parturients with eclampsia at a tertiary referral hospital in Cape Town

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Background: Anaesthesia for caesarean section (CS) in women with eclampsia is a major clinical challenge, and there are limited data concerning the rationale for the choice of technique, and short-term outcomes. A retrospective audit was performed on practice at a tertiary referral centre in Cape Town.
Methods: The primary outcome of the audit was the proportion of patients with eclampsia receiving either spinal anaesthesia (SA) or general anaesthesia (GA) for CS, and an assessment of the rationale for the choice of method. In addition, short-term maternal and neonatal outcomes were recorded.
Results: There were 11 exclusions in 100 patient records screened, therefore 89 were analysed. Seven/89 (7.9%) patients received SA and 82/89 (92.1%) GA. Overall, 63/89 (70.8%) patients had a preoperative GCS < 14, and 26/89 (29.2%) ≥ 14. Seven/26 patients with GCS ≥ 14 had SA; the remaining 19/26 received GA. GA was performed because there was no platelet count available in three, pulmonary oedema in two, difficult airway due to a bitten tongue in two, fetal bradycardia in two, HELLP syndrome in one, renal failure in one, and patient refusal in one patient. In seven women, there was no clear reason for GA.
Median (IQR) Apgar scores at 1 minute in SA patients (8 [8–9]) were higher than those in GA patients with GCS ≥ 14 (5 [3–6]) and < 14 (4 [2–6]), $p = .008$ and .001 respectively. At five minutes, neonates of SA patients had median scores of 10 [9–10], compared with 8 [7–8] in those of GA patients with GCS ≥ 14, and 8 [7–9] in those with GCS < 14, $p = .007$ and .019 respectively. There were two stillbirths and two neonatal deaths in the GA group.
Patients with GCS ≥ 14 receiving GA required mechanical ventilation for 0 [0–1] days, and those with GCS < 14 were ventilated for 1 [1–2] days. No patients receiving SA required postoperative ventilation, compared with 5/19 (26.3%) patients with GCS ≥ 14 who received GA. Seven/63 patients with GCS < 14 had cerebral oedema, and two had a cerebral infarct. There were two maternal deaths.
Conclusions: The small percentage of women with eclampsia who received SA for CS, experienced good maternal and fetal outcomes, and more patients could have safely received SA. Larger prospective audits in high- and low-resource environments are required to establish factors influencing the context-sensitive choice of method of anaesthesia, and risk versus benefit of GA versus SA for CS in women with eclampsia.

Keywords: eclampsia, general anaesthesia, spinal anaesthesia, pregnancy

Introduction

Hypertensive disorders of pregnancy remain one of the leading direct causes of maternal and perinatal morbidity and mortality in South Africa. A recent cohort study at facility level in South Africa reported a 1% mortality in 1 547 women with preeclampsia, of whom 147 (9.5%) developed eclampsia. Of 1 589 births, there were 332 (21%) perinatal deaths, of which 281 (84.6%) were stillbirths.[1] The latest Report on Confidential Enquiries into Maternal Deaths (2014–2016) indicates 661 maternal deaths in patients with hypertensive disorders of pregnancy, with the most primary obstetric complications being eclampsia, severe hypertension, HELLP syndrome (haemolysis, elevated liver enzymes, low platelet count) and liver rupture.[2] Eclampsia was the largest sub-category contributing to maternal death. Cerebral complications were the single most common final cause of death in patients with hypertensive disorders (357/661 [54%]).

Spinal anaesthesia (SA) has become the method of choice for caesarean section (CS) in women with preeclampsia, in the absence of contraindications, if an epidural catheter has not been placed in labour.[3] Anaesthesia and perioperative care for eclamptic patients remain challenging, and there is little published literature on the rationale for the choice of anaesthesia in this high-risk category of patients. Current clinical opinion is that in patients with GCS < 14, general anaesthesia (GA) should be practised adhering to the principles of neuro-anaesthesia, with postoperative ventilation.[4]

In a five-year retrospective review by Moodley et al., epidural anaesthesia was compared with GA for CS in stable conscious women (GCS ≥ 14) with eclampsia.[5] It was concluded that there were no major complications in either group, and that maternal and neonatal outcomes are not affected adversely by the use of epidural anaesthesia in selected patients with stable eclampsia. Patients in the epidural anaesthesia group had higher one-minute Apgar scores. In addition, a recent prospective case series of 12 stable eclamptic parturients who received SA, concluded that SA avoids the risks associated with GA, and was not associated with major complications.[6]

We performed a retrospective audit of anaesthesia for CS in women with eclampsia. The primary outcome of the audit was

the proportion of patients with eclampsia receiving either SA or GA for CS, and an assessment of the rationale for the choice of the method of anaesthesia. In addition, short-term maternal and neonatal outcomes were described. The audit sought to provide data which could inform the design of larger prospective studies on the practice of SA versus GA in women with eclampsia in high- and low-resource environments.

Methods

After approval by the Human Research Ethics Committee of the Faculty of Health Sciences of the University of Cape Town (HREC ref 222/2014), the audit was performed on a convenience sample of the 100 most recently admitted patients with a diagnosis of eclampsia requiring CS, from June 2009 to September 2013, in the Maternity Centre at Groote Schuur Hospital, a high-risk referral unit in Cape Town, South Africa. Anaesthesia was usually performed by registrars, often supervised by specialist anaesthetists. Eclampsia was defined as the new onset of grand mal seizure activity and/or unexplained coma during pregnancy or the postpartum period in a woman with signs or symptoms of preeclampsia after 20 weeks' gestation. Eclampsia was treated by seizure prophylaxis using 4 g magnesium sulphate IV followed by 1 g hourly, and occasionally diazepam or midazolam. The goal of blood pressure management was to reduce systolic blood pressure to < 160 mmHg employing combinations of dihydralazine and labetalol.

The anaesthesia technique was at the discretion of the anaesthesiologist. Briefly, SA for CS was performed at the L3–4 interspace, using 10 mg bupivacaine and 10 µg fentanyl. Rapid sequence induction for GA was performed using either thiopentone or propofol, and combinations of bolus alfentanil and/or IV magnesium sulphate to obtund the response to tracheal intubation, followed by suxamethonium. Anaesthesia was maintained with N_2O/oxygen and isoflurane, and morphine was administered after delivery. Either intermittent boluses of suxamethonium or small doses of rocuronium were used for ongoing muscle relaxation.

A folder review was conducted to include data obtained from anaesthesia charts, and obstetrics notes made during the obstetrics critical care unit admission. A case number was assigned once the patient was identified in the hospital register, and anonymity ensured. Data obtained from the patient folders were captured on an Excel spreadsheet (Microsoft Excel, Redmond, WA).

Data recorded were patient demographics and presenting symptoms and signs, the highest systolic blood pressure before treatment, the number of seizures before the operation, the airway assessment and potential trauma to the oro-pharynx, urgency of delivery, and the indication for CS. Also recorded were the platelet count, if known, at the time of surgery, and the presence of HELLP syndrome, as well as the haemoglobin level.

In-theatre data included the Glasgow Coma Scale (GCS) and oxygen saturation with the patient breathing room air before induction of anaesthesia, the Mallampati score in cooperative patients, the type of anaesthesia administered and the reason(s) for the choice, the highest and lowest in-theatre systolic blood pressures, and any intraoperative complications.

Maternal morbidity was estimated by number of days spent in the obstetrics critical care unit, the number of days of mechanical ventilation, ongoing neurological deficit and any evidence of neurological injury on CT-scan imaging, the development of HELLP syndrome, or pulmonary oedema. Mortality was documented.

Fetal birth weight, Apgar scores at one and five minutes, and mortality were also recorded.

Results were expressed as number (%), mean (standard deviation), or median [interquartile range], as appropriate. One- and five-minute Apgar scores in patients receiving SA and GA with GCS ≥ 14 and < 14, were compared using the independent-samples Kruskal-Wallis test. For the Kruskal-Wallis dependent variables which were significant, a post-hoc Dunn-Bonferroni pairwise comparison was conducted. The statistical software used was Statistical Package for the Social Sciences (SPSS) version 24 (SPSS Inc., Chicago, IL, USA).

Results

The records of 100 patients requiring CS were reviewed. After excluding 11 patients who either did not fulfil the diagnostic criteria for eclampsia, or had normal vaginal deliveries, 89 patients were analysed. GA for CS was performed in 82/89 (92%). One/89 patients received GA after suffering a seizure during positioning for SA. Seven/89 (7.9%) patients received SA, of whom none had GCS < 14. The clinical details of all women with eclampsia appear in Table I.

Overall, 63/89 (70.8%) had a preoperative GCS < 14, and 26/89 (29.2%) patients had GCS ≥ 14. In the latter group, 7/26 patients had SA, and the remaining 19/26 received GA. In these 19 patients, GA was performed because there was no platelet count available in three, pulmonary oedema in two, difficult airway due to a bitten tongue during a seizure in two, fetal bradycardia in two, HELLP syndrome in one, renal failure in one, and patient refusal in one. In seven cases, there was no clear reason why GA was chosen.

The recorded number of preoperative seizures in patients who had SA and GA with a GCS ≥ 14 were 2 [2–2] and 2 [1–3] respectively. In one case from each group, seizures continued into the postoperative period.

The details of perinatal and maternal outcome appear in Table II.

Pairwise comparisons showed that median [IQR] Apgar scores at one minute in neonates of SA patients (8 [8–9]) were higher than those in GA patients with GCS ≥ 14 (5 [3–6]) and < 14 (4 [2–6]), $p = .008$ and .001 respectively. The proportion (%) of neonates with one-minute Apgar scores ≥ 7 in patients who had SA, was 6/7 (85.7), compared with 3/22 (13.6) and 12/67 (17.9) in patients having GA with GCS ≥ 14 and < 14 respectively. At five minutes,

Table I: Clinical details of all eclamptic patients

	Spinal anaesthesia (*n* = 7)	General anaesthesia (*n* = 82)	
	GCS ≥ 14	GCS ≥ 14 (*n* = 19)	GCS < 14 (*n* = 63)
Age (years)	23 (7)	23 (5)	23 (5)
Parity			
0	5 (71)	12 (63)	38 (60)
1+	2 (29)	7 (37)	25 (40)
Gestation (weeks)	34 (3)	35 (3)	34 (4)
Weight (kg)	62 [58–76]	67 [57–84]	66 [56–74]
Symptoms and signs			
Cerebral oedema proven (CT scan)	0	0	7 (11)
Pulmonary oedema	0	2 (11)	2 (3)
Intubated and ventilated	0	0	6 (10)
Seizure in theatre	0	0	4 (6)
Seizures			
Number of seizures	2 [2–2]	2 [1–3]	3 [2–4]
Seizures before CS	6 (86)	18 (95)	61 (97)
Seizures before AND after CS	1 (14)	1 (5)	2 (3)
Indication for CS			
Maternal	4 (57)	7 (37)	42 (67)
Fetal	1 (14)	10 (53)	13 (21)
Maternal AND fetal	2 (29)	2 (11)	8 (13)
SpO_2 before induction	97 (2)	98 (1)	97 (3)
Airway			
Cormack-Lehane grade	N/A	1 [1–2]	1 [1–1]
Trauma to the tongue	2 (29)	6 (32)	21 (33)
Haemodynamic details			
Highest SBP before treatment (mmHg)	179 (19)	177 (24)	172 (24)
First SBP on anaesthesia chart	163 (25)	169 (25)	168 (29)
Highest intraoperative SBP	166 (16)	183 (31)	173 (25)
Lowest intraoperative SBP	129 (17)	123 (23)	119 (19)
Anaesthesia complications			
Pulmonary aspiration	0	0	1 (2)
Difficult intubation	N/A	1 (5)	0
Blood results			
Haemoglobin (g/dL)	11 [11–13]	12 [11–13]	12 [11–13]
Platelet count ($\times 10^9$/L) if known	263 [206–278]	216 [141–294]	198 [160–265]
Platelet count unknown	0	4 (21)	6 (10)

Values are given as number *n* (%), mean (SD) or median [IQR], CS – caesarean section, CT – computerised tomography, GCS – Glasgow Coma Scale, mmHg – millimetres mercury, SBP – systolic blood pressure, SpO_2 – peripheral oxygen saturation breathing room air, SD – standard deviation

SA patients had scores of 10 [9–10], compared with 8 [7–8] in GA patients with GCS ≥ 14, and 8 [7–9] in those with GCS < 14, $p = .007$ and .019 respectively. The two neonatal deaths were due to multiple congenital abnormalities, and septic shock following meningitis.

Two patients had postoperative echocardiography. One had clinical pulmonary oedema with a normal cardiac ultrasound, except for a small pericardial effusion. The other had HELLP syndrome and renal failure requiring dialysis, with persistent tachycardia, a mildly dilated right ventricle, and left ventricular hypertrophy.

Eighty-five/89 (95.5%) patients were admitted to the obstetrics critical care unit postoperatively. The median length of stay in patients with GCS ≥ 14 was one day in the SA and GA groups, and two days in those who had GA and GCS < 14. None of the seven patients receiving SA required postoperative ventilation, whereas 5/19 (26.3%) patients with GCS ≥ 14 who received GA required ventilation for one day. Six patients had tracheal intubation before CS and received mechanical ventilation perioperatively. Six patients with GCS < 14 were treated for aspiration pneumonia, one of whom had pulmonary aspiration in theatre. None of the patients with GCS ≥ 14 in either SA and GA groups had clinically proven cerebral oedema, however seven

Table II: Neonatal and maternal outcomes

	Spinal anaesthesia (*n* = 7)	General anaesthesia (*n* = 82)	
	GCS ≥ 14 (*n* = 7)	GCS ≥ 14 (*n* = 19)	GCS < 14 (*n* = 63)
Neonatal outcome*			
Live birth	7 (100)	20 (91)	65 (97)
Stillbirth	0	1 (5)	1 (1.5)
Neonatal death	0	1 (5)	1 (1.5)
Apgar scores			
1 min	8 [8–9]	5 [3–6]	4 [2–6]
5 min	10 [9–10]	8 [7–8]	8 [7–9]
≥ 7 at 1 min	6 (86)	3 (14)	12 (18)
≥ 7 at 5 min	7 (100)	17 (77)	53 (79)
Birth weight			
Live birth	2351 (653)	2278 (707)	2306 (818)
Maternal outcome			
Days in CCU	1 [1–2]	1 [1–2]	2 [1–3]
Patients ventilated postoperatively	0	5 (26)	50 (79)
Days ventilated	0	0 [0–1]	1 [1–2]
Other morbidity			
Alive	7	19	61
Demised	0	0	2

Values are given as number *n* (%), mean (standard deviation), or median [IQR]
GCS – Glasgow Coma Scale, CCU – critical care unit, *Twin deliveries were included

patients who had a GCS < 14 and received GA had evidence of cerebral oedema on CT scan. One patient had an infarct in the left middle cerebral artery territory, and another had a lacunar infarct. There were two maternal deaths. One had severe cerebral oedema, and the other patient had HELLP syndrome with intracerebral haemorrhage.

Discussion

This retrospective audit of anaesthesia for CS in eclampsia at a tertiary referral unit in Cape Town, South Africa, showed that only 7/89 (8%) of women had SA. All patients with a GCS < 14 (63/89) received GA; however, 19/26 with a normal GCS received GA, often with no reason for this choice. This is in contrast with practice in Nigeria, where a recent audit reported that 65/82 (79%) women with eclampsia received SA.[7] Previous work had shown increasing use of SA for CS in preeclampsia/eclampsia in a referral centre in Nigeria from the period 1998–2002 (9/125 [7%]) to 2002–2006 (25/71 [35%]), with no anaesthesia deaths in the latter period.[8] Our findings were that SA in patients with eclampsia and GCS ≥ 14 appears to be safe and possibly associated with better outcomes for both mother and child.

The main anaesthesia considerations with respect to GA in eclampsia are: management of a difficult airway (including the risk of pulmonary aspiration), obtunding the hypertensive response to tracheal intubation, maintaining cerebral perfusion pressure in the presence of raised intracranial pressure (both intra- and postoperatively), and fetal sedation. In addition, anaesthesia expertise is limited in low-resource areas.

Current clinical opinion is that patients with eclampsia, GCS < 14, and a high likelihood of raised intracranial pressure, should receive GA with similar considerations as in neuro-anaesthesia. These include the maintenance of cerebral perfusion pressure, and postoperative ventilation with careful sedation until neurological recovery is achieved, in an intensive care unit.[4] In limited resource environments, the capacity for postoperative ventilation is often not available. For example, 12/82 (15%) of women received mechanical ventilation in a report from Nigeria.[7]

For SA, the main challenges are: the performance of dural puncture in a patient with raised intracranial pressure, the performance of SA in an uncooperative patient, the risk of epidural haematoma, and potential delay in a patient with fetal bradycardia. If one extrapolates from research in patients with severe preeclampsia receiving SA,[3] maternal hypotension is unlikely in the absence of haemorrhage or other comorbidities.

A detailed analysis of the rationale for the choice of anaesthesia technique in the 26/89 patients with GCS ≥ 14, showed that only seven received SA. In the remaining 19 women, GA was performed for a number of reasons: no platelet count available, renal failure, pulmonary oedema, difficult airway due to a bitten tongue during a seizure, fetal bradycardia, HELLP syndrome, and patient refusal. In seven cases, there was no clear reason for the choice of GA.

It is of interest that four patients in this series of eclamptic women had a platelet count < 75 x 10^9/L; all had GA. The incidence of epidural haematoma is low following spinal anaesthesia in obstetrics, at approximately 1:200 000.[9] In a large retrospective

cohort study, 1 524 patients with platelet counts < 100 × 10^9/L were identified who had received neuraxial anaesthesia in obstetrics. There were no cases of epidural haematoma. However, the upper bound of the 95% CI of the risk of epidural haematoma was 11% for the range 0–49 × 10^9/L, and 3% for the range 50–69 × 10^9/L, due to limited observations.[10] The incidence of thrombocytopaenia in pregnancy with a platelet count < 75 × 10^9/L is approximately 1%.[11] A thromboelastography study showed that the maximum amplitude decreased markedly in patients with preeclampsia when the platelet count decreased to below 75 × 10^9/L.[12] In a recent Pregnancy Practice Bulletin of the American College of Obstetricians and Gynecologists, the recommended lower limit of the platelet count for safe neuraxial anaesthesia is 80 × 10^9/L.[13] All this information should be taken into account when deciding on the risk/benefit of performing spinal anaesthesia in patients with stable eclampsia, when there is thrombocytopaenia, or a platelet count is not available.

One patient in the audit presented major anaesthesia challenges in that she had acute renal failure and severe hypertension. The indication for GA was uraemia, but it is unlikely that there was a coagulation risk, considering that she also had thrombocytosis (platelet count 700 × 10^9/L).

Patients with eclampsia who develop pulmonary oedema and hypoxaemia, should be adequately managed before CS, in the interests of maternal safety. In women with diastolic dysfunction and well-preserved systolic function, SA may be feasible after diuresis, but very carefully titrated GA is preferable if the ejection fraction is not preserved. Point of care echocardiography has been shown to be useful in the assessment of ventricular function in patients with preeclampsia complicated by pulmonary oedema, but is not often available in limited resource environments.[14-15]

In hypertensive patients with trauma to the airway following a seizure, in whom there is no contraindication to regional anaesthesia, SA could be considered a safer option than GA. The same applies to the seven patients in our audit receiving GA with no clear indication.

One patient had a seizure during preparation for SA, and was converted to GA. Magnesium sulphate is the most effective agent for preventing recurrent seizures in eclampsia; in the Collaborative Eclampsia Trial, patients allocated magnesium sulphate had a 52% lower risk of further convulsions than those receiving diazepam (13% vs 28% respectively).[16] In addition, the intraoperative period is very short, so that the occurrence of seizures at that time is uncommon. Nevertheless, clinicians should be prepared and ready for this occurrence.

In a previous study comparing outcomes following GA versus neuraxial anaesthesia for CS in conscious women with stable eclampsia, epidural anaesthesia was favoured over SA. "Stable eclampsia" implied that the blood pressure did not require acute management, GCS was ≥ 14, the fetal heart tracing was normal, platelet count was > 100 × 10^9/L, that magnesium therapy was in progress, and central venous pressure was maintained at 4–6 cm H_2O. Epidural anaesthesia was found to be associated with similar maternal and neonatal outcomes as GA, except for higher one-minute Apgar scores in the epidural group.[5] This study was conducted before the acceptance of spinal anaesthesia as the method of choice in women with preeclampsia for CS in the absence of contraindications, if no labour epidural catheter is in place.[3] In the recent paper describing experience with anaesthesia in women with eclampsia in Nigeria, the term "stable" eclampsia is used in the title. It is however unclear whether all women receiving SA had GCS ≥ 14, or whether this influenced the choice of anaesthesia technique.[7] A subsequent case series described good haemodynamic stability in a series of 12 women with stable eclampsia receiving SA for CS.[6] Our study also showed that stable eclamptic women had minimal haemodynamic changes during SA for CS; three patients required small doses of vasopressor, and fetal Apgar scores were good.

The two patients in our audit who demised both had GCS < 14 on presentation, and experienced intracerebral haemorrhage and severe cerebral oedema. In the study of Afolayan et al., 9/17 (53%) of GA patients, compared with 1/65 (1.5%) of those receiving SA, died in the intensive care unit.[7]

A study conducted at a teaching hospital in Nigeria reported a stillbirth rate of 23% of 120 mothers with eclampsia, birth asphyxia in 39% and low birth weight in 26%.[17] Our study showed lower one- and five-minute Apgar scores in neonates of patients receiving GA, and an audit from Nigeria reported lower five-minute scores in the GA group. Despite the limitation that these are observational studies, it appears that fetal sedation by GA may increase the requirement for resuscitation in these compromised babies.

In circumstances in which referral to a specialised unit is not possible, the clinician has to make the difficult choice between GA and SA, considering all the above factors carefully in the individual case. For example, the risk of epidural haematoma in the presence of thrombocytopaenia or in the absence of a platelet count may be very much lower than the risk of tracheal intubation in an obese patient with a bitten tongue and severe hypertension.[18] The decision should be context-sensitive, and take into consideration the expertise of the clinician, the possibility of referral to tertiary care units, and available equipment and experience with its use.[19] In patients who have had several seizures, focal neurological signs, and/or HELLP syndrome, SA should be avoided.

Limitations of our study are the fact that it was a single-centre retrospective folder audit, and that the results are not generalisable to low-resource environments.

Our results, together with existing literature, suggest that in view of the undoubted risks associated wit GA, careful consideration should be given to the possibility of SA in each individual patient with eclampsia and GCS ≥ 14. Our study paves the way for major audits on anaesthesia-related outcomes in both high- and low-resource environments, where it is likely that there is a differing emphasis on GA and SA. Such appraisals of practice

could be followed by larger prospective studies on the choice of anaesthesia technique, and maternal and perinatal outcomes in eclampsia.

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Conflict of interest

The authors declare no conflict of interest.

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Ethics approval

Approval was granted by the Human Research Ethics Committee of the Health Sciences Faculty of the University of Cape Town (HREC Ref 222/2014). Informed consent was not obtained from patients whose data was included in this audit. Anonymity was strictly maintained.

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