

THE ROLE OF THE ANAESTHETIST IN THE MANAGEMENT OF PRE-ECLAMPSIA

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Pre-eclampsia is a major cause of maternal mortality and morbidity, and fetal loss worldwide, but particularly in the third world.

Anaesthetists may be required to assist with pain management in labour, to provide anaesthesia for Caesarean Section and to assist in the Intensive Care Management of life-threatening complications which may arise from this condition.

DEFINITION

The cardinal features of this condition are hypertension and proteinuria, occurring for the first time after 20 weeks gestation. Pre-eclampsia is further classified into mild, moderate or severe groups. Mild pre-eclampsia is defined in a previously normotensive woman as a diastolic blood pressure in excess of 90mmHg with proteinuria of less than 0.3g/24hrs.

Severe pre-eclampsia is said to exist if one or more of the following is present:

- Systolic blood pressure > 160 or diastolic pressure > 110 mmHg on two readings 6 hours apart
- Rapidly increasing proteinuria (>3g/24hrs)
- Oliguria of < 400 ml/24 hours
- Evidence of cerebral irritability or visual disturbance
- Pulmonary oedema or cyanosis

Eclampsia is diagnosed with any degree of hypertension if convulsions occur.

AETIOLOGY

It is generally agreed that the essential disorder is utero-placental ischaemia, although the underlying mechanism for this has not yet been conclusively found. There is, however, a geographic and a socio-economic distribution with the condition being far commoner in developing countries, favouring either a genetic predisposition or a nutritional component.

PATHOPHYSIOLOGY

It is currently thought that a tissue factor is released from the ischaemic placenta affecting endothelial cells widely throughout the maternal circulation, resulting in occlusive spasm of arterioles involving:

Central Nervous System (CNS) CNS irritability is witnessed by headaches, visual disturbances, hyperreflexia and ultimately convulsions. The aetiology of this is more likely to be on the basis of vasospasm and hypoxia rather than cerebral oedema as was originally thought. Convulsions are not directly related to an elevation in blood pressure (as compared with hypertensive encephalopathy).

Cardiovascular System (CVS) The generalised arterial vasospasm leads to a decreased circulating blood volume with variable amount of tissue oedema. The systemic vascular resistance is increased as is the left ventricular stroke work index, leading to left ventricular strain. Consequently there may be left ventricular diastolic dysfunction with poor correlation between the central venous and pulmonary capillary wedge pressures.

Coagulation Up to one third of patients have thrombocytopaenia, and in severe cases platelet counts may fall rapidly. In addition, there appears to be a qualitative platelet dysfunction. Severe

cases may develop the HELLP syndrome, (Haemolysis, Elevated Liver Enzymes, Low Platelets), and disseminated intravascular coagulopathy.

Respiratory System Pulmonary involvement is uncommon until late in the course of the disease when pulmonary oedema and upper airway (especially laryngeal) oedema may occur. Pulmonary oedema occurs most frequently after delivery.

Liver There is reduced enzyme activity with raised liver enzymes particularly in the HELLP syndrome possibly due to areas of necrosis or ischaemia. Hepatic rupture is a rare, but often lethal, complication.

Kidneys The prevalence of proteinuria indicates glomerular involvement, probably on a vascular basis. Oliguria is more commonly due to hypovolaemia and decreased renal blood flow rather than primary renal pathology. Progress to acute renal failure is common, especially with hypotension and the HELLP syndrome. However, renal outcomes are generally good.

Feto-placental Unit The reduced placental perfusion results in a high prevalence of intra-uterine growth retardation. There is also a high incidence of abruptio placentae and preterm labour. Early delivery of the baby is often required and results in fetal prematurity.

MEDICAL MANAGEMENT

The management of these patients is both operative and non-operative. The anaesthetist should be involved in both facets of care in severe pre-eclampsics, as expertise in intensive care techniques, particularly cardiovascular monitoring and control and in the field of pain management can be invaluable.

AIMS to reduce maternal and foetal complications:

- Treat hypertension
- Control of convulsions
- Fluid therapy and treatment of oliguria
- Decision when to deliver
- Management of coagulation abnormalities

Control of Hypertension The aim is to keep the mean arterial pressure between 100 - 140mmHg (130/90-170/110mmHg). It is important to maintain

placental perfusion and reduction of the blood pressure to normal levels may be inappropriate.

Bed rest with avoidance of aorto-caval compression may be all that is required.

Vasodilatation should be preceded by volume expansion to avoid falls in blood pressure:

(a) **Hydralazine** is administered intravenously in 5mg increments followed by intravenous infusion at 5 - 20mg/h titrated against the blood pressure. This agent is a direct-acting vasodilator and is the most widely used drug for the control of pre-eclamptic hypertension. The onset time of dihydralazine is slow (about 15 minutes) and 20 minute intervals should be allowed between increments; if insufficient time is allowed, severe hypotension may occur.

Hypotension and tachycardia generally respond to infusion of fluids.

(b) **Methyldopa** is generally reserved for patients with an element of chronicity to their hypertension. It is used in standard doses but may cause drowsiness, depression and postural hypotension. It has a long history of safety in pregnancy used in the dose of 1 - 3g daily in divided doses.

(c) **Nifedipine** Although a logical choice, nifedipine has not been widely studied for use in PET. It's principal use has been in the acute management of very high blood pressures with 10 mg orally being the usual dose. Short-acting nifedipine is supplied as a bite-and-swallow capsule and is much more effective and reliable when used in this way, as opposed to the widespread practice of giving it sublingually.

(d) **β blockers** Fears of the effects of β blockade on the fetus makes the routine use of these agents in the at-risk pregnancy inadvisable. However, Labetalol has been used successfully in a small series of patients.

(e) **Nitroprusside / Nitroglycerine (by continuous infusion)** Nitroglycerine acts primarily on the venous capacitance vessels and is less effective following volume expansion. Nitroprusside, with it's rapid onset and brief duration, would appear an ideal agent, however, fears of cyanide toxicity in the foetus has limited its use to short term blood pressure control. There are also doubts as to its safety in the presence of raised

intracranial pressure, such as may occur in a patient who has had several convulsions.

Intravenous fluid therapy Some authors claim that plasma volume expansion per se can induce vasodilatation and reduce blood pressure, improving regional blood flow and optimising the effect of vasodilator drugs. However, in severe pre-eclampsia and especially post-delivery, left ventricular dysfunction combined with a low plasma oncotic pressure, can combine to produce a high incidence of pulmonary and cerebral oedema. In severe cases therefore, pulmonary capillary wedge pressure monitoring is mandatory when plasma volume expansion is contemplated. The absolute value of the central venous pressure is valueless as a guide to the risk of pulmonary oedema. However, careful titration of the fluid load against CVP response is a useful way of determining the ability of the ventricle to handle the volume imposed.

Management of convulsions Magnesium sulphate is now established as the agent of choice for the prevention of recurrent eclamptic convulsions. The place of magnesium infusions for the prophylaxis of convulsions in pre-eclamptic patients remains to be established. There is also no clarity in the literature as to the best agent for the termination of an eclamptic convulsion.

(a) **Magnesium Sulphate** is a potent cerebral vasodilator, as well as a powerful catecholamine antagonist. The therapeutic blood level lies between 2 and 4mmol/l. There are two commonly accepted dosage regimens:

The combined intramuscular and intravenous regime in which a 4gm intravenous dose, infused over 20minutes, is combined with a 10gm intramuscular injection followed by 5gm intramuscularly into each buttock every 4 hours thereafter.

The intravenous regime in which the 4gm loading dose is followed by a continuous infusion of 1 to 3 gm per hour to maintain the therapeutic level.

The major danger of magnesium infusion is neuromuscular blockade, which is a linear function of the plasma magnesium concentration. Neuromuscular monitoring by the hourly testing of patellar tendon reflexes is the standard method of determining the early onset of toxicity. If depression of the reflexes occurs, stop the infusion until the

reflexes return. Magnesium is exclusively excreted by the kidneys, and diminished renal function is a relative contraindication to the use of this ion.

(b) **Diazepam** is still widely used as the first line agent to terminate a convulsion and is given in 5 - 10 mg increments until effective. Diazepam infusions of 10mg/h have been used prophylactically but may produce excessive sedation with the consequent risks to the airway. Fetal depression, especially in a premature infant has been a major factor in the decline of the use of this drug. Magnesium is now the preferred agent.

(c) **Phenytoin** Although this drug was widely used in the past for the prevention and control of eclamptic convulsions, recent evidence no longer supports its use.

Prophylaxis for convulsions should be started with signs of cerebral irritability such as headache, visual disturbances, epigastric pain or hyperreflexia. Following a single eclamptic convulsion, prophylaxis with magnesium sulphate should always be instituted, unless there are major contraindications. Hypertension alone is not necessarily an indication for anticonvulsant therapy; convulsions may occur at moderately elevated blood pressures and blood pressure alone is a poor predictor of the likelihood of occurrence of a convulsion.

The decision to deliver. The obstetrician normally makes this decision in consultation with the paediatrician and in severe cases with the anaesthetist. It is often a balance between maternal morbidity and fetal viability. Commonly, the mother is presented for Caesarean Section at a time when her disease is most severe.

ANAESTHESIA and ANALGESIA

Optimisation If not already achieved by the obstetrician, the anaesthetist needs to ensure that the intravascular volume and renal function is optimised as well as the control of hypertension and the anti-convulsant therapy.

Labour analgesia In mild or moderate pre-eclampsia, the patient may be allowed to proceed with normal labour. Provided coagulation is normal, the early institution of an epidural block may often be useful in the management of these patients, both for the control of blood pressure and vasodilatation as well as reducing the stress response and catecholamine release that may be induced by pain.

It is also thought that regional anaesthesia improves placental intervillous blood flow. There is the possibility that concomitant magnesium infusion may increase the degree of hypotension that may accompany epidural blockade. However, this seems unlikely to be sufficiently severe to compromise placental blood flow, which may be selectively preserved by magnesium infusion.

Operative Management - anaesthetic technique
General anaesthesia vs. regional anaesthesia - How to decide which?

The interest of both mother and fetus as well as the technical ability of the anaesthetist involved need to be considered. (A familiar technique is safer for all parties than a more technically correct method with which the anaesthetist is unfamiliar).

General anaesthesia is the only recommended technique in patients with diminished level of consciousness e.g. eclampsia or immediately post-ictal or the following problems:

- imminent eclampsia

- serious coagulation of abnormalities,
- anatomical problems interfering with insertion of the regional block
- sepsis at the site of the proposed regional block

The relative advantages of general and regional anaesthesia in pre-eclampsia are summarised in table 1.

Conduct of General Anaesthesia

a) Assessment of airway Prediction of airway oedema is not always possible but the presence of stridor and/or facial oedema may be a clue. The Mallampati score may change remarkably during labour, and should always be performed immediately prior to the performance of general anaesthesia. Post-convulsion, laceration of the tongue or mucosa may also be warning signs of a difficult intubation. In these cases, awake nasotracheal intubation may be necessary. However, the unpredictability of airway difficulty in these patients behoves the anaesthetist to have the

Table 1.

	Regional Anaesthesia		General Anaesthesia	
	Advantages	Disadvantages	Advantages	Disadvantages
Airway	No intubation response No risk of failed intubation	No control	Control	Exaggerated intubation response Increased risk of failed intubation
Convulsions	Nil	No active control Risk of convulsion	Control	
Drugs and technique	No sedative drugs	Risk of convulsions Risk of high block		Maternal awareness Fetal depression
Speed	Spinals quick - 5-10 min	Epidural - slow 20-30 mins	Fast - less than 5 minutes	
Blood Pressure control	Lower catecholamines Less instability	Risk of hypotension	Less hypotension	Increased catecholamines Increases in BP, PAWP, CVP with intubation
Coagulation	No airway instrumentation	Risk of haematoma	Avoid spinal haematoma	Risk of airway haemorrhage

facilities available for a difficult or impossible intubation (introducers, laryngeal masks, surgical airway etc.) for every case.

b) Induction should be in accordance with standard obstetric practice:

Pre-oxygenation for at least three minutes followed by a rapid acting induction agent; thiopentone 4 - 5 mg/kg or etomidate 0.2mg/kg (not ketamine); and suxamethonium (1- 1.5mg/kg).

During this time, however, a method of reducing haemodynamic responses to laryngoscopy and intubation should be employed. Some of the methods used have proven injurious to fetal well-being, e.g. lignocaine, β blockers and the longer acting opioids. Vasodilators (nitroglycerine and nitroprusside) have been used but worries of fetal cyanide toxicity and maternal intracranial pressure have limited their use.

Alfentanil, given prior to the suxamethonium dose at 10mcg/kg produces obtunding of the pressor response with minimal fetal depression because of its short duration of action.

Magnesium sulphate, has a vasodilatory, as well as an anti-catecholamine action. Given as a 40 mg/kg bolus intravenously just after the induction, it can obtund the pressor response without excessive hypotension to follow (Remember this is a painful injection when given awake). MgSO₄ and alfentanil can be used together in severe cases, with doses lowered accordingly (30mg/kg + 7.5mcg/kg), but if maternal risk is high (MAP (180) higher doses can be used (60mg/kg + 30mcg/kg). Hypotension following the intubation response is not uncommon, especially in combination with a volatile agent.

Lignocaine is less effective than alfentanil or magnesium. If it is to be used, a dose of 1.5mg/kg should be given intravenously 3-5 minutes before induction

Precurarisation, especially where magnesium has been used is not recommended, as it may lead to severe muscle weakness prior to induction. Remember that after magnesium, the usual fasciculations following suxamethonium may not occur, and a timed 60 seconds after suxamethonium administration should be allowed before attempting intubation.

Depolarising muscle relaxants should be used with caution, in smaller doses, and preferably with neuromuscular monitoring. It is our practice to use an infusion of suxamethonium, starting at 4 mg/min but also using a nerve stimulator to maintain relaxation sufficient to facilitate surgery.

Anaesthesia is best maintained with moderate to low concentrations (0.5 - 1 MAC) of Isoflurane (considering possible cerebral vasospasm and/or oedema), and a suitable opiate after delivery. We usually use 10 - 15mg morphine given immediately after delivery. Halothane may also be used, although isoflurane is preferable if there are signs of raised intracranial pressure

c) Extubation. Exaggerated CVS responses to extubation are often overlooked, but can be as severe and disastrous as those of intubation. MgSO₄ and Alfentanil here are illogical and vasodilators, (β blockers (especially Esmolol), and possibly lignocaine may be used.

Conduct of Regional Anaesthesia

It has long been argued that spinal anaesthesia, except for the mildest of hypertension, is not suitable for PET, as precipitous hypotension may result. More recently though, several authors have studied the use of spinals for severe forms of the disease, with some good results. Although hypotension remains a problem, particularly in view of a conservative attitude to fluid loading, it has been shown that utero-placental flow is not diminished, presumably through arteriolar vasodilatation, and may even be enhanced.

It is our view that stable hypertensives on vasodilatory treatment (methyldopa, nifedipine, hydralazine) are good candidates for spinal anaesthesia, as they tend to drop their blood pressure less than those on no treatment. However, for the uncontrolled, newly diagnosed or severely hypertensive cases, an epidural seems to be the regional anaesthetic technique of choice, provided there is no need for rapid fetal delivery (abruptio placentae, severe fetal bradycardia). As with the spinal, the better the preoperative medical management (fluids + vasodilators) the less problem there is with hypotension. The possibility of running the epidural postoperatively, where a high percentage of cardiopulmonary complications can occur, make this an attractive option.

Conduct of epidural and spinal anaesthesia is according to that of regular practice:

a) Spinal Our guidelines suggest the use of a 25G or smaller pencil point needle, with 1.6 - 2.0 ml of "heavy" (with dextrose), bupivacaine 0.5% depending on the height and abdominal girth of the patient. Taller patients get a bigger dose, whereas heavier patients, with more pressure on their spinal space, need a smaller volume. The block height aimed for is T6, ideally.

b) Epidural The cannula is sited in L2/3 or L3/4 interspace and the standard test dose is used. The loading or main dose should be given in stages rather than as a single large bolus, so as to raise the height of the block slowly, again aiming for a T6 sensory level.

Our practice is to use 10mcg of fentanyl with the spinal and 50 - 100mcg with the epidural main dose. This has the effect of making the sensory component of the block denser.

Hypotension cannot be simply treated with a free hand in terms of crystalloid volume. A more balanced approach is to use some synthetic colloid (500ml starch solution) and crystalloid (Ringer's lactate 1000ml), as well as ephedrine in 5mg increments, as this will not adversely affect uterine blood flow.

POSTOPERATIVE CARE

Seventy percent of convulsions and pulmonary complications occur in the postoperative period in pre-eclampsia. Laryngeal oedema may worsen during the operative procedure and airway embarrassment, sufficiently severe to require re-intubation, may follow extubation. Anti-hypertensive therapy should be continued for as long as clinically indicated and anticonvulsant medication maintained for as long as the patient remains symptomatic. Invasive monitoring, if used

intra-operatively, should be continued in the intensive care environment post-operatively. Good quality post-operative analgesia can contribute to the ease of management of these cases. Continued meticulous attention must be paid to fluid balance and the correction thereof in the presence of oliguria.

CONCLUSIONS

The management of the severe pre-eclamptic presents a considerable clinical challenge. The expertise of anaesthetists in the provision of pain relief, management of cardiovascular function, the control of fluid balance, management of respiratory function and familiarity with the drugs used makes them potentially key figures in the multi-disciplinary management of these patients. The provision of anaesthesia and analgesia for operative and non-operative delivery of these patients provide a particular clinical challenge requiring considerable skill and experience on the part of the anaesthetist.

Further Reading

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