Guideline Title  
Pre-Eclampsia Management in ICU

Summary:  
Patients admitted to ICU with pre-eclampsia will be managed as per the maternity guidelines for management of hypertensive disorders of pregnancy.

Approved by: ICU Director  
Publication (Issue) Date: October 2013  
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Replaces Existing Guideline: Nil  
Previous Review Dates: Nil

Background Information:

1. Introduction contains:  
The risk addressed by this policy:

Patient Safety and correct management of patient with Pre-Eclampsia in ICU

The Aims / Expected Outcome of this policy:

Staff caring for a patient with pre-eclampsia in ICU will have the knowledge and skills required to provide effective and safe care of the patient in accordance with the recommendations of the ICU Medical team.

Related Policies  
PD2011_064 Maternity - Management of Hypertensive Disorders of Pregnancy  

2. Policy Statement:  
- All care provided within Liverpool Hospital will be in accordance with infection prevention/control, manual handling and minimisation and management of aggression guidelines.

Definition and Diagnosis for Pre-Eclampsia:

Hypertension in pregnancy is defined as:  
1. Systolic blood pressure greater than or equal to 140 mmHg and/or  
2. Diastolic blood pressure greater than or equal to 90 mmHg (Korotkoff 5)  
These measurements should be confirmed by repeated readings over several hours.

Severe hypertension in pregnancy is defined as:  
1. Systolic blood pressure greater than or equal to 170 mmHg and/or  
2. Diastolic blood pressure greater than or equal to 110 mmHg.
Pre-eclampsia is defined as:
Hypertension that arises after 20 weeks gestation and is accompanied by one or more of the following:

- Renal involvement
  - Significant proteinuria – dipstick proteinuria subsequently confirmed by spot urine protein/creatinine ratio ≥ 30mg/mmol. In view of the close correlation between spot urine protein/creatinine ratio and 24 hour urine excretion, the latter is rarely required.
  - Serum or plasma creatinine > 90 μmol/L
  - Oliguria

- Haematological involvement
  - Thrombocytopenia
  - Haemolysis
  - Disseminated intravascular coagulation

- Liver involvement
  - Raised serum transaminases
  - Severe epigastric or right upper quadrant pain

- Neurological involvement
  - Convulsions (eclampsia)
  - Hyperreflexia with sustained clonus
  - Severe headache
  - Persistent visual disturbances (photopsia, scotomata, cortical blindness, retinal vasospasm)
  - Stroke

- Pulmonary oedema
- Fetal growth restriction
- Placental abruption
- Oedema is not included in the diagnosis of Preeclampsia, however, rapid development of generalised oedema is usually abnormal. Peripheral oedema can occur in normal pregnant women

3. Principles / Guidelines
3.1 Risk factors for Pre-Eclampsia:
- Primigravida
- Multigravida with new partner
- Previous Preeclampsia in a pregnancy with same partner
- Family history of Preeclampsia
- Multiple pregnancy
- Obesity
- Renal disease
- Essential hypertension
- Diabetes
- Autoimmune disease, especially SLE and antiphospholipid syndrome
- Thrombophilic state
- Severe alloimmunisation

3.2 Signs of worsening Preeclampsia
- **Neurological:** careful clinical monitoring should detect premonitory signs of convulsions such as hyper-reflexia with clonus, retinal vasospasm, visual disturbances and persistent headaches. Women with any of the above signs may be considered for convulsion prophylaxis with magnesium sulphate.
3.3 Indications for admission to Intensive Care Unit.

Women with pre-eclampsia may require close monitoring and management in an Intensive care unit. Some of the indications for admission to ICU/HDU are:

- Pulmonary edema
- Sepsis
- Intractable hypertension
- Acute renal failure with oliguria or anuria
- Repeated seizures.
- Massive blood loss and disseminated intravascular coagulation
- Neurological impairment requiring ventilation (eg: intracerebral haemorrhage or infarction, cerebral edema).
- Intra-abdominal pathology (eg: acute fatty liver, liver or arterial aneurysm rupture, adrenal haemorrhage).

3.4 Management of Pre-Eclampsia:

A team approach, involving obstetrician, midwife, neonatologist, anaesthetist and ICU staff specialist provides the best chance of achieving a successful outcome for mother and baby.

Preeclampsia is a progressive disorder that will inevitably worsen if pregnancy continues. Delivery is the definitive management and is followed by resolution, generally over a few days but sometimes much longer. At mature gestational age, delivery should not be delayed. Even so, it is important to control severe hypertension and other maternal derangements before subjecting the woman to the stresses of delivery. Detailed management is outlined in the following policy:

PD2011_064 Maternity - Management of Hypertensive Disorders of Pregnancy


Management goals in Intensive care include:

3.4.1 Acute treatment of severe hypertension.
3.4.2 Prevention of further seizures
3.4.3 Invasive monitoring and intravenous fluid management
3.4.4 Thromboprophylaxis
3.4.5 Delivery – decision and arrangements made by the obstetric team.

3.4.1 Acute treatment of severe hypertension

Consider antihypertensive treatment when blood pressure is SBP 140-160mmHg and/or DBP 90-100mmHg on more than one occasion. Severe hypertension that requires immediate treatment is SBP ≥170mmHg and DBP ≥110mmHg.

The following can be used singly or in combination to control BP during the antenatal and postnatal period:

- First line agents: hydralazine, labetalol, oxprenolol, clonidine and methyldopa.
- Second line agents: nifedipine and prazosin

NB: ACE Inhibitors and Angiotensin Receptor Blockers are unsafe at any gestation.
**Hydralazine**: This is the most commonly used intravenous anti hypertensive agent in pre-eclampsia.

**Indications:**
- If systolic ≥170mmHg OR diastolic ≥ 110mmHg for two readings.
- Eclampsia.
- At lower levels of BP than above, but where there are persistent symptoms and/or failed oral anti-hypertensive therapy.
- In situations where oral administration of medication is impossible or unreliable such as, in labour or the unconscious state.

**Aim:** To achieve a gradual reduction in BP to safe levels (90mmHg diastolic), rather than a precipitate drop.

**NOTE:** the risk of sudden hypotension can be greater in women with a contracted plasma volume.

**Incompatibilities:** Glucose-containing solutions, ampicillin, aminophylline, hydrocortisone and sulphadiazine. **DO NOT mix hydralazine with syntocinon**

**Hydralazine Bolus Dose**
- Consider administering a fluid bolus of 500ml 0/9% sodium chloride prior to administering bolus of hydralazine.
- Reconstitute 20mgs hydralazine (1ampoule) with 1mL water for injection, then dilute with 0.9% sodium chloride to a total of 20mL (final concentration = 1mg/ml).
- Administer 5mLs (5mgs) bolus by slow intravenous injection. Dose can be repeated at 20 minute intervals, up to a maximum of 3 doses.
- Record BP, pulse and fetal heart rate (if applicable) every 5 minutes after each bolus dose. Continue 5 minutely observations until stable, then measure hourly.
- The aim of therapy is a diastolic pressure between 90-100mm/Hg. Dramatic drops to values less than this may precipitate fetal distress.

**Hydralazine Infusion**
Persistent hypertension despite 3 boluses of IV Hydralazine 5mg may be due to a compensatory reflex tachycardia:

**If heart rate <125 bpm commence hydralazine infusion (via syringe driver):**
- Take 3 ampoules of 20mg hydralazine (60mg). Reconstitute one ampoule each with 1mL sterile water for injection to make a total of 3mL (60mg) hydralazine.
- Dilute 60mg hydralazine with sterile 0.9% sodium chloride to a total of 60ml (final concentration = 1mg/mL).
- Run infusion at 10mL/hr
- Increase rate by 5mL/hr, every 15 minutes until BP is controlled
- Continue 15 minutely BP and pulse for first hour of infusion, then measure hourly if stable (where feasible continuous monitoring of blood pressure via arterial line should be used).

**If heart rate >125 bpm:**
Give oral clonidine, labetolol or oxprenolol in addition to Hydralazine infusion.

**If the woman is still pregnant, then the fetus should be continuously monitored.**

**When to cease Hydralazine infusion**
- Hydralazine infusion should be ceased when BP is suitably controlled by oral or intermittent IV medications. Decision to be made by ICU Staff specialist and O&G Registrar or VMO
- Continue on oral antihypertensive medication after IV Hydralazine infusion ceased.
Continue with 4th hourly observations when BP stable.

### Other Antihypertensive medications for preeclampsia:

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Route</th>
<th>Action</th>
<th>Practise Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methyl dopa</td>
<td>250 - 75mg tds</td>
<td>Oral</td>
<td>Central acting antiadrenergic</td>
<td>Slow onset of action over 24 hour. Dry mouth, sedation, depression, blurred vision. Withdrawal effect with clonidine</td>
</tr>
<tr>
<td>Clonidine</td>
<td>75-300 μg tds</td>
<td>Oral</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labetalol</td>
<td>100-400mg tds</td>
<td>Oral</td>
<td>β blocker with mild alpha vasodilator effect</td>
<td>Bradycardia, bronchospasm, headache, nausea, scalp tingling which usually resolves within 24-48 hours (labetalol only)</td>
</tr>
<tr>
<td>Oxprenolol</td>
<td>20-160mg tds</td>
<td>Oral</td>
<td>β blocker</td>
<td></td>
</tr>
<tr>
<td>Nifedipine</td>
<td>20mg bd–60mg SR bd</td>
<td>Oral</td>
<td>Ca channel Antagonist</td>
<td>Severe headache associated with flushing, tachycardia Peripheral edema, constipation</td>
</tr>
<tr>
<td>Prazosin</td>
<td>0.5 - 5mg tds</td>
<td>Oral</td>
<td>α blocker</td>
<td>Flushing, headache, nausea, lupus-like syndrome</td>
</tr>
<tr>
<td>Hydralazine</td>
<td>25-50 mg tds</td>
<td>Oral</td>
<td>Vasodilator</td>
<td>Flushing, headache, nausea, lupus-like syndrome</td>
</tr>
</tbody>
</table>

3.4.2 **Prevention of further seizures.**

Diazepam 5-10mg IV should be used to terminate ongoing seizures. Take care with additive effects on respiratory depression when both diazepam and magnesium are used.

**Magnesium Sulfate** infusion is the agent of choice for seizure prophylaxis. Patients on an infusion should be monitored in a HDU /ICU environment.

**Indications**
- Seizure prophylaxis in a woman following eclamptic seizure;
- Seizure prophylaxis in a woman with severe preeclampsia at risk of eclampsia.

**Relative Contraindications**
Magnesium sulfate can be extremely hazardous in the following circumstances:
- Renal failure, severe renal compromise, or if oliguria is present (magnesium concentration can reach toxic levels as elimination is predominantly renal). Half dose magnesium sulphate should be considered if there is renal compromise
- In association with hypocalcaemic states.
- Myasthenia gravis.
- Cardiac conditions, in particular conduction problems, myocardial damage, or patients on digoxin.
**Other considerations:**

**Magnesium sulfate:**
- May lower blood pressure (secondary to vasodilatation). Dose of any current antihypertensive medication may require adjustment
- May have some tocolytic effect;
- May decrease fetal heart rate variability;
- May cause loss of reflexes (patellar reflexes will be absent well before toxic serum levels of magnesium are reached);
- Should be used with caution in the presence of calcium antagonists or other respiratory depressants (e.g. valium).

**Common maternal side effects:**
- Sensation of pain and warmth in arm
- Flushing of hands, face and neck
- Nausea

**Signs of maternal toxicity:**
- Loss of patellar reflexes
- Respiratory rate < 10
- Slurred speech, weakness, feeling extremely sleepy, double vision
- Muscle paralysis
- Respiratory / cardiac arrest

**Antidote for magnesium toxicity:**
- Calcium chloride or calcium gluconate (10ml of 10% solution) by slow intravenous injection over 3 minutes.

**Dosage and Administration**
- Administration of Magnesium sulphate should always be via an infusion pump or syringe driver.
- The Magnesium Sulphate line should not be used to inject other drugs, therefore it should run on its own dedicated lumen.
- Presentation: Magnesium Sulfate 10mmol (2.467 g/5mL) in 5mL ampoule
- **Recommended loading dose**: 4g MgSO4 (8mls) over 15 - 30 minutes depending on pump used
- **Maintenance dose** of 1g MgSO4 per hour
- Maintenance infusion should continue for a **minimum** of 24 hours

**Infusion Pump Protocol**

<table>
<thead>
<tr>
<th>Loading Dose</th>
<th>Syringe Pump Protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>4g MgSO4 diluted in 0.9% sodium chloride via infusion pump over 20 – 30 minutes</td>
<td>Loading Dose 4g MgSO4 given via syringe pump over 15 minutes (4g equals 8ml).</td>
</tr>
<tr>
<td>- Using a 500ml bag of 0.9% sodium chloride, run 100 mls into burette</td>
<td>- Using a 50mL syringe, draw up 8mL of magnesium using 2 x 5ml ampoules of 10mmol (2.465 g/5mL) magnesium sulfate.</td>
</tr>
<tr>
<td>- Add 8mls (4g) of MgSO4 (50% solution) to the 100mls of 0.9% sodium chloride in the burette</td>
<td>- Infuse the 8mL = 4grams of magnesium sulfate, at a rate of 32mL/hour over 15 minutes via the syringe driver.</td>
</tr>
<tr>
<td>- Infuse over 20 – 30 minutes via infusion pump</td>
<td><strong>Maintenance Dose</strong> 1g per hour via syringe pump</td>
</tr>
</tbody>
</table>

**Loading Dose**

- Remove 20 mls 0.9% sodium chloride from the Normal Saline remaining in the bag and discard. Add 20 mls (10g) of MgSO4 (50% solution) to the remaining 50mL of Normal Saline.

**Maintenance Dose**

- Draw up 10 ampoules of magnesium sulfate 10mmol (2.465 g/5mL) in a 50mL syringe, to gain a concentration of 100mmol/50mL or 25grams/50mL.
**Care and observations during infusion:**

Close observation and assessment (maternal and fetal) is required for the duration of the infusion. Where patient condition is unstable, the frequency of observation will need to be increased.

- Hourly recording of maternal blood pressure, respiratory rate, heart rate and urine output.
- (Cease infusion if respiratory rate is < 10 per minute or if urine output is < 80mls over four hours)
- Patellar reflexes at completion of loading dose and then 2 hourly. (Cease infusion if unable to elicit reflexes)
- Fetal heart rate monitoring as clinically indicated.
- Serum magnesium levels may be measured 60 minutes after commencing the infusion and thereafter as clinically indicated. Normal therapeutic levels are 1.5-3.5 mmol/L. (Blood for serum levels should not be collected from the limb receiving the infusion).

**Dose Alterations**

- **Mg level >3.5mmol/L:** Cease MgSO₄ infusion and inform O&G Registrar. Assess reason for elevated Mg level and if appropriate, recommence infusion at a reduced rate
- **Mg level <1.5 mmol/L:** May increase by increments, with maximum increase of 1g/hour from maintenance rate to 2g/hour

**Toxic Effects**

- Mg Level of 4.0 – 5.0 mmol/L - Loss of patellar (biceps) reflexes, weakness, nausea, double vision and slurred speech. Loss of reflexes is a very useful sign of impending serious toxicity, so regular testing of reflexes is recommended.
- Mg Level of 6.0 – 8.0 mmol/L - Respiratory depression/arrest.
- Mg Level > 12 mmol/L - Cardiac Arrest.

**Discontinuation of MgSO₄ therapy**

The duration of use of MgSO₄ and the timing of the cessation of infusion post-birth should be considered when signs and symptoms of disease have abated and risk of eclampsia is minimal – discussion between ICU team and obstetrician.

Once minimum therapy had been delivered, 4 clinical and laboratory parameters can be used to determine whether intravenous magnesium sulphate could be discontinued:

1. Preceding 6 hours characterised by absence of persistent headache, visual change, or epigastric pain;
2. >50% of hourly postpartum systolic BP’s ≤ 150 mmHg and diastolic values ≤ 100 mmHg, with no single systolic pressure ≥ 160 mmHg or single diastolic pressure ≥ 105 mmHg
3. Presence of a spontaneous diuresis of ≥ 100 ml/hr for 2 consecutive hours without a fluid challenge or frusemide stimulation; and
4. <100 mg/dl urinary protein on dipstick evaluation of a catheterised urine specimen.

**Recurrent Seizures**

These should be managed with:

- IV Diazepam 5-10mg to terminate seizures
Consider Midazolam Infusion if seizures continue

3.4.3 Invasive monitoring and intravenous fluid management

- Invasive monitoring may be necessary to assess hemodynamic status. This includes arterial blood pressure monitoring. Monitoring CVP, use of pulmonary artery catheter, PiCCO or echocardiography for cardiac output monitoring.
- Intravenous fluids should be administered cautiously to avoid the risk of pulmonary edema.
- Administration of intravenous maintenance fluid at a rate greater than normal requirements should only be considered for:
  - Women with severe preeclampsia immediately prior to parenteral hydralazine, regional anaesthesia or immediate delivery
  - Initial management in women with oliguria where there is a suspected or confirmed deficit in intravascular volume.
- As vascular permeability is increased in women with preeclampsia administration of large volumes of intravenous fluid before or after delivery may cause pulmonary oedema and worsen peripheral oedema. This tendency is further aggravated by hypoalbuminaemia.
- Appropriate blood product replacement is necessary when there has been haemorrhage, as in cases of placental abruption.
- Post-partum oliguria is a regular accompaniment of preeclampsia and care must be taken to avoid its over-treatment. Persistent oliguria beyond 24 hours post-partum with rising plasma creatinine suggests the possibility of post partum renal failure.

3.4.4 Thromboprophylaxis

- Preeclampsia is a risk factor for thrombosis, particularly in the presence of additional risk factors such as obesity, age above 35 years, previous thrombotic event, family history of thrombosis and nephrotic range proteinuria.
- When women are admitted to ICU for management of pre-clampsia they will usually be relatively immobile and graduated compression stockings and calf compressors should be considered, with or without prophylactic low molecular weight heparin (LMWH).
- Postnatal thromboprophylaxis should be administered to women with preeclampsia except where there is a surgical contraindication.

3.4.5 Delivery

Arrangements for delivery should be decided once the woman’s condition is stable. In the meantime, close fetal monitoring should be maintained.

Preeclampsia occurring at term (>37 weeks) is an indication for delivery.

When the fetus is preterm, especially when gestation is <32 weeks, conservative management with careful monitoring of maternal and fetal wellbeing is usually recommended.

The decision regarding timing, mode, location of and indications for birth should be assessed on an individual basis and involve all members of the team caring for the woman. However, general indications for delivery are:

- Inability to control BP despite adequate hypertensive therapy
- Deteriorating liver function
- Deteriorating renal function
- Progressive thrombocytopenia
- Placental abruption
- Neurological complications or imminent eclampsia
- Non reassuring CTG and/or concern regarding fetal welfare
4. **Performance Measures**

All incidents are documented using the hospital electronic reporting system: IIMS and managed appropriately by the NUM and staff as directed.

6. **References / Links**


**Author:** ICU CNC, S.Shunker

**Reviewers:** ICU Medical Director, Staff specialists, ICU NM, NUMs, CNEs & CNSs, Obstetrics and Gynaecology Staff Specialists, NUM, CNC & CNEs.

**Endorsed by:** ICU Medical Director: A Prof. Michael Parr