



Paediatric & Obstetric Anaesthesia

Pocket Handbook



Maytinee Lilaonitkul
Nick Boyd

Paediatric Quick Reference

Normal Physiology ranges:

Age	Respiratory rate (per min)	Heart rate (per min)	Normal Systolic BP (mmHg)	Lowest Systolic BP (mmHg)
< 1 yr	30-40	110-160	80-90	65-75
1-2 yr	25-35	100-150	85-95	70-75
2-5 yr	25-30	95-140	85-100	70-80
5-12 yr	20-25	80-120	90-100	80-90
>12 yr	15-20	60-100	100-120	90-105

Weight estimation:

(only to be used if weighing the child is not possible)

Birth	3 – 3.5 kg
6 months	7.5 kg
1 year	10 kg
Over 1 year	(Age in years + 4) x 2
<i>Above 10 years this formula may underestimate weight</i>	

Emergency drugs and equipment:

ETT size (mm)	(Age / 4) + 4.5
ETT length (cm)	(Age / 2) + 12
Fluid bolus	10 – 20 ml/kg
Adrenaline (in cardiac arrest)	10 mcg/kg IV 0.1 ml/kg of 1:10,000
10% glucose bolus	2 ml/kg
Atropine	20 mcg/kg IV
Suxamethonium	2 mg/kg IV 4 mg/kg IM
Defibrillation	4 J/kg

Foreword

Safer Anaesthesia From Education (SAFE) obstetric and paediatric courses have been developed for anaesthesia providers in low resource settings. This pocket handbook is designed to accompany the SAFE courses and to be used in clinical practice. The aim is to provide a quick reference guide for essential information and includes drug doses, important calculations and management protocols. The SAFE courses are supported by the Association of Anaesthetists of Great Britain and Ireland (AAGBI) and the World Federation of Societies of Anaesthesiologists (WFSA). We would like to thank the WFSA for funding this handbook.

Disclaimer

We have worked hard to ensure that all of the information provided in this handbook is accurate and up to date. Whilst every care has been taken to ensure that doses and recommendations are correct, the responsibility for final checking must rest with the prescriber. The authors cannot accept any responsibility for errors in this publication.

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Back cover: WHO Surgical Safety Checklist 2009. http://whqlibdoc.who.int/publications/2009/9789241598590_eng_Checklist.pdf ©World Health Organization. All rights reserved. Reproduced with permission from the World Health Organization

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Paediatric Anaesthesia

Preoperative considerations

It is important to have a structured approach for pre-assessing a child for surgery. The following should be undertaken as a minimum:

History

Child's age and weight

- Only use weight estimation if actual weight not possible

History of the current medical condition / reason for surgery

Past medical history

- Chronic illnesses (e.g. asthma, diabetes)
- Congenital conditions / syndromes (e.g. Down's syndrome, cardiac disease)
- Does this child need specialist review? (see page 6)

Previous operations and problems with anaesthesia

- Family history of problems with anaesthesia

Current medical status including:

- Upper respiratory tract infections (see page 6)
- Current illnesses (e.g. malaria)
- Nutritional status

Medications

- Regular medications
- Medications given prior to operation (e.g. paracetamol)

Allergies

Fasting status (see page 5)

Examination

Airway and breathing

- Evaluate airway – could the child be difficult to intubate?
- Examine chest for respiratory rate and added sounds
- What are the oxygen saturations?

Circulation

- Heart rate and blood pressure
- Is the child well hydrated?
- Signs of anaemia? Is there a heart murmur?
- Assess sites for IV access

Investigations

Look at any investigations that have been done

Consider asking for additional tests, if required
(e.g. blood tests, cross match, malaria, sickle cell)

Explanation and Consent

Explain anaesthetic induction plan

- Explain to parents and child (if old enough to understand) what to expect at the induction of anaesthesia
- If appropriate, consider giving the child the choice of IV or gas induction

Consent parents for the risks of the anaesthetic

- Consent for common and serious risks of anaesthetic
- Consent for any additional procedures that you are planning (e.g. caudal or local anaesthetic block)

Fasting guidelines

Oral intake	Minimum fasting time (before induction)
Clear fluids	2 hours
Breast milk	4 hours
Solids (including formula milk)	6 hours

- Problems associated with **prolonged fasting**:
 - Dehydration
 - Difficult venous access
 - Hypoglycaemia
 - Irritable and miserable at induction
- Babies and small children should be scheduled **first** on an elective list to avoid prolonged dehydration
- If the operation will be delayed, allow the child to have clear fluids until **2 hours before induction of anaesthesia**
- **Sickle cell patients** in particular should avoid dehydration due to the risk of sickle cell crises

Upper Respiratory Tract Infection (URTI) guidance

An active URTI can increase the risk of complications, including:

- Laryngospasm and bronchospasm
- Airway obstruction
- More rapid desaturation

Therefore, **elective surgery** should be cancelled and postponed for **four weeks** if the following symptoms are present:

- Systemic illness (malaise, reduced appetite) with a fever above 38°C
- Productive cough
- Purulent nasal discharge
- Chest signs on auscultation (wheeze, crackles, reduced air entry)

High risk children

Children who need paediatric review, further pre-operative investigations and possible transfer to a specialist centre include:

- Premature babies and neonates
- Oxygen saturations in air of less than 94%
- Heart disease
- Sickle cell disease
- Severely malnourished children
- Significant systemic diseases
- Congenital abnormalities or diseases

Heart murmurs are common and it can be difficult to decide if a child has a 'flow' murmur or a more concerning abnormality.

Pathological heart murmurs are generally loud and may be associated with a thrill. Signs that may indicate significant heart disease include:

- **Babies:** cyanosis, sweating on feeding, hepatomegaly, failure to thrive
- **Younger children:** cyanosis, tachypnoea, failure to thrive
- **Older children:** cyanosis, history of reduced exercise tolerance, fainting episodes

Airway Equipment

Facemask

Fits comfortably from bridge of nose to below the mouth, without pressing on the eyes



Oral (Guedel) airway

Estimated as the distance from the incisors to the angle of the jaw



Endotracheal tube (ETT)

Internal Diameter (ID) for uncuffed tube (in mm):

- Neonate ETT size = **3.0 – 3.5**
- 1 yr old ETT size = **4.0 – 4.5**
- 2yrs and older ETT size = **(Age / 4) + 4.5**

In addition to preparing the expected tube size, always prepare one size bigger and one size smaller

ETT length at teeth (in cm) = **(Age / 2) + 12**

This length is only a guide. Care must be taken to ensure the correct length for every patient (using tracheal tube markings and/or clinical examination)

Laryngeal Mask Airway (LMA)

LMA size	Weight of child
1	< 7.5 kg
1½	7.5 – 12.5 kg
2	12.5 – 20 kg
2½	20 – 30 kg
3	> 30 kg

Circulation

Normal physiological values according to age:

Age (years)	Heart Rate (per min)	Systolic BP (mmHg)
< 1	110 – 160	80 – 90
1 - 2	100 – 150	85 – 95
2 - 5	95 – 140	85 – 100
5 - 12	80 – 120	90 – 110
> 12	60 – 100	100 – 120

Estimated Blood Volume = 80 mls/kg

Resuscitation Fluids:

Fluid bolus for resuscitation = 10 – 20 mls/kg

Blood bolus = 8 mls/kg of whole blood
(or 5 mls/kg of packed cells)
increases Hb by approximately 1g/dL

Glucose bolus = 2 mls/kg of 10% dextrose
10% dextrose can be made by diluting 50% dextrose
(e.g. 4mls of 50% dextrose diluted with 16mls of water)

Choice of fluid:

- Use 0.9% saline or Ringer's Lactate
- **NEVER** use 5% dextrose for resuscitation fluids

Maintenance Fluids

- **Always give oral fluids where possible**
- If unable to tolerate oral fluids, use IV regime below:

HOURLY intravenous fluid requirement (4-2-1 rule)¹

Weight of child	mls/kg/hr
First 10kg	4
Second 10kg	2
Every additional kg	1

Example: Maintenance fluids for a 25kg child

first 10kg = (4×10) = 40mls/hr
second 10kg = (2×10) = 20mls/hr
additional 5kg = (1×5) = 5mls/hr
Total maintenance fluid requirement= 65mls/hr

Choice of fluid:

- 5% dextrose 0.9% saline **or**
 - 5% dextrose 0.45% saline **or**
 - 5% dextrose Ringer's Lactate
-
- **NEVER use 5% dextrose for maintenance fluids**

¹Holliday M, Segar W. The maintenance need for water in parenteral fluid therapy. *Pediatr* 1957;19:823-32

Paediatric Pain Assessment

Use the most appropriate assessment tool for the child's age or development:

- Age 0 - 5 years **FLACC scale**
- Age 4 -12 years **Faces pain scale**
- Age 6 years and above **NRS / VAS**

Face, Legs, Activity, Cry, Consolability (FLACC) Scale

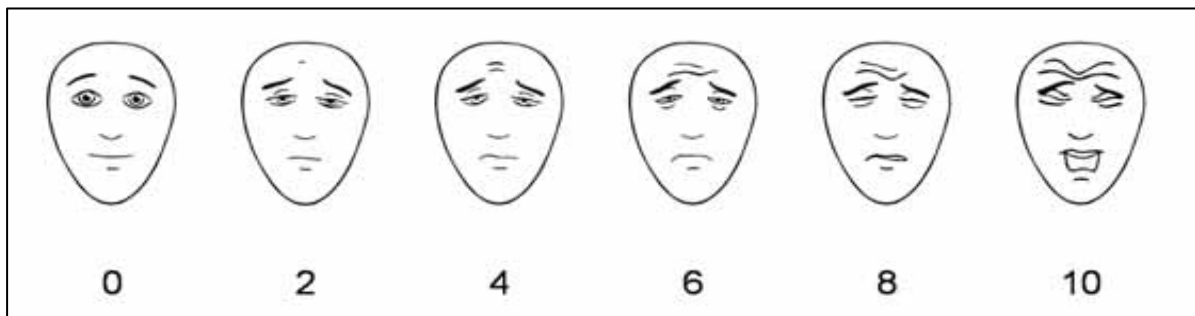
- Five elements to assess pain
- Scores added up to give total score out of 10

	SCORE		
	0	1	2
Face	No particular expression or smile	Occasional grimace, disinterested	Frequent grimace, clenched jaw
Leg	Normal position	Uneasy, restless, tense	Kicking or legs drawn up
Activity	Normal position, moving easily	Squirming, shifting back and forth, tense	Arched, rigid or jerking
Cry	No cry (awake or asleep)	Moans or whimpers	Crying steadily, screaming
Consolability	Content, relaxed	Reassured by hugging or being talked to	Difficult to console or comfort

Merkel S et al. The FLACC: A behavioural scale for scoring post-operative pain in young children.
Paediatr Nurse 1997; 23 (3): 293-7

Faces pain scale

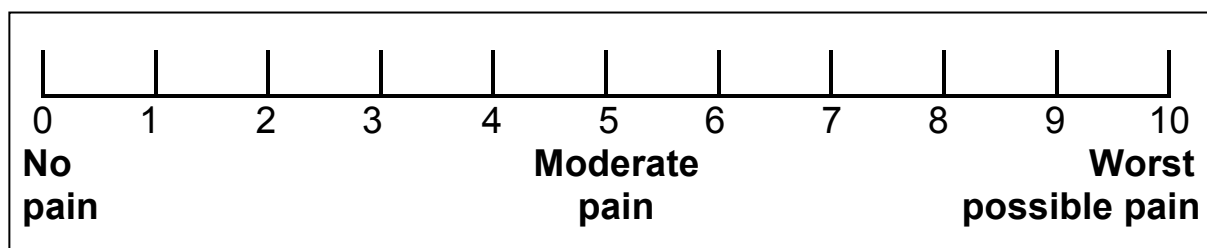
- Assessment of pain based on child's facial expression



Hicks CL et al. The Faces Pain Scale – Revised: Toward a common metric in pediatric pain measurement. *Pain*, 2001; 93: 173-83

Numeric rating scale (NRS) and Visual analogue score (VAS)

- Child asked to indicate how much pain they have on a line with 0 being no pain and 10 being the worst possible pain
- An example of the NRS is shown below



Evaluating pain scores:

PAIN SCORE	SEVERITY OF PAIN
0	None
1 - 3	Mild
4 - 7	Moderate
8 - 10	Severe

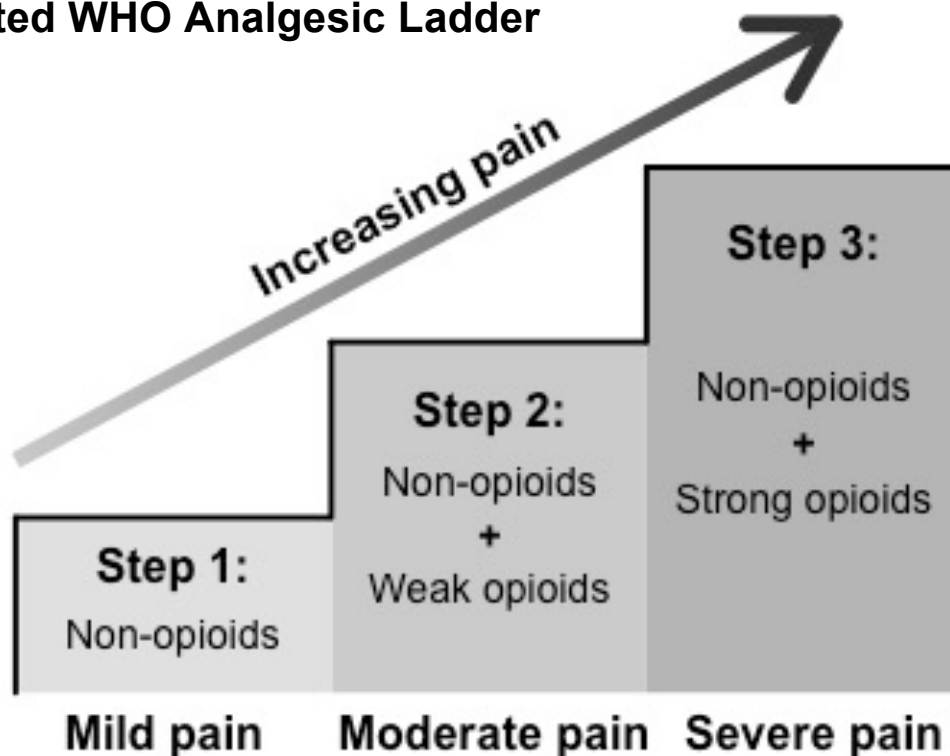
- Treat if moderate or severe pain
- Reassess 30 minutes later
- Use WHO analgesic ladder to treat pain, based on the severity of pain

Pain Management

Basic principles

- Always use a **multimodal analgesia approach**:
Combine different classes of analgesia to achieve effective pain relief with minimal side effects
- Use **WHO analgesic ladder**
- Give analgesics **regularly**. Do not wait until severe pain develops as it will be more difficult to treat
- Use **least invasive route**. Give oral medications where possible
- All opioids can cause **respiratory depression** and require careful observation
- **Ketamine can be useful for severe postoperative pain**. It has anaesthetic properties so it should only be administered by an experienced practitioner and requires careful observation

Adapted WHO Analgesic Ladder



Non-Opoids	Mild Opoids	Strong Opoids
Paracetamol Ibuprofen / Diclofenac	Codeine Tramadol	Morphine Pethidine Fentanyl

Adapted from WHO Pain Relief Ladder. www.who.int/cancer/palliative/painladder/en/

Paediatric Analgesia Dosage Guidelines				
	Oral Dose	IV Dose	PR Dose	Important notes
NON-OPIOIDS				
Paracetamol	15mg/kg; 6 hourly	15mg/kg; 6 hourly	20mg/kg; 8 hourly	Max 60mg/kg/day. Liver damage in overdose
Ibuprofen (NSAID)	5mg/kg; 6 hourly (Only over 1 month)	-	-	Max 30mg/kg/day. Avoid in renal failure and asthmatics. Do not use with other NSAIDs
Diclofenac (NSAID)	1mg/kg; 8 hourly (Only > 6 months)	0.5mg/kg; 8 hourly (Only > 2yrs old)	1mg/kg; 8 hourly (Only >6 months)	Max 150mg/day. Avoid in renal failure and asthmatics. Do not use with other NSAIDs
MILD OPIOIDS				
Codeine	1mg/kg; 6 hourly (Only >12yrs old)	-	-	Max 240mg/day. Avoid in obstructive sleep apnoea.
Tramadol	1mg/kg; 6 hourly (Only > 1yr old)	1mg/kg ; 6 hourly (Only > 1yr old)	-	Caution in epilepsy
STRONG OPIOIDS				
Morphine	<u>Under 1 yr old:</u> 0.1mg/kg 4-6 hourly <u>1 yr old and older:</u> 0.2-0.4mg/kg 4 hourly Max. dose of 10mg	<u>Under 1 yr old</u> Loading: 0.02-0.1mg/kg Max 0.4mg/kg in 4 hours <u>1 yr old and older:</u> Loading: 0.05-0.1mg/kg Max. 5mg per dose, may be repeated to max. of 20mg	-	Calculate EXACT doses for child's weight Prolonged risk of respiratory depression Start with lowest dose Do not use regularly with other opioids
Pethidine	-	0.5-1mg/kg; 4 hourly (Only >1yr old)	-	Seizures possible in high dosages
Fentanyl	-	1-2 mcg/kg	-	Potent respiratory depression Only to be given by experienced practitioner
OTHER				
Ketamine	-	0.2 - 0.5mg/kg IV 2 - 4 mg/kg IM	-	Only to be given by experienced practitioner

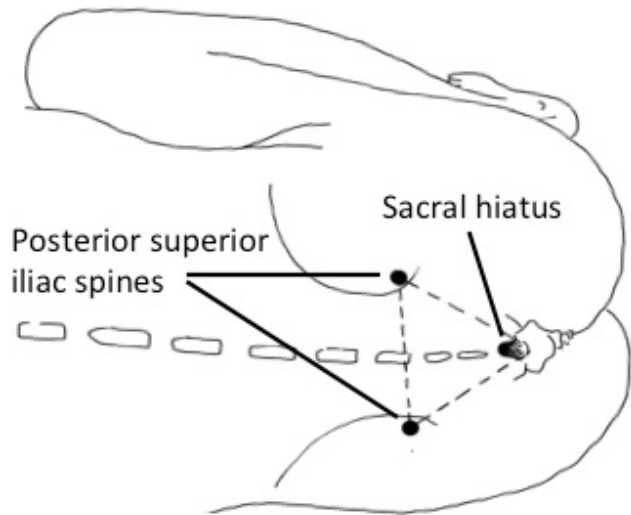
Caudal block

Indications

- Surgery below umbilicus (e.g. inguinal hernia, club foot repair)

Anatomy

- The caudal space is identified by locating the sacral hiatus, found at the apex of an equilateral triangle, where the posterior superior iliac spines form the other two corners



Technique

- Usually performed under general anaesthesia
- Position patient in lateral position with knees drawn into chest
- Identify landmarks and clean skin with antiseptic solution
- Using a 22G cannula or 23G needle, insert the needle into the sacral hiatus at 45° to skin. If you hit bone, withdraw slightly and flatten angle before advancing needle again
- A subtle “give” or “pop” will be felt as the needle enters the caudal space. If using a cannula, gently advance the plastic cannula a further 2mm and remove the needle. Ensure no CSF or blood returns from the needle or catheter
- Attach a syringe with local anaesthetic (see below), aspirate to check there is no blood and inject local anaesthetic slowly
- If it is in the correct position, it should be easy to inject the local anaesthetic and there should be no skin swelling

Local anaesthetic doses

- Use **preservative free bupivacaine**
- Scrotal/genital surgery: **0.5 ml/kg** of 0.25% bupivacaine
- Inguinal surgery (T10-12): **0.75 ml/kg** of 0.25% bupivacaine
- Peri-umbilical (T6-10): **1 ml/kg** of 0.25% bupivacaine
- 0.25% bupivacaine will provide analgesia for 4-6 hours

Side effects / risks

- Failed block, motor block, infection, bleeding, intravascular injection, urinary retention, inadvertent sub-arachnoid block

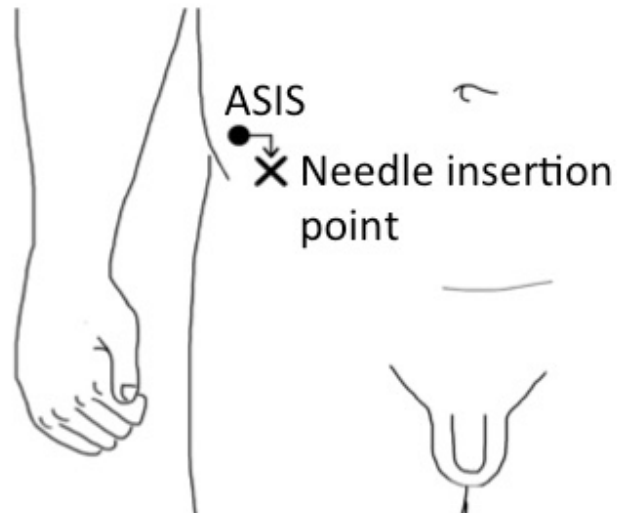
Ilioinguinal block

Indications

- Simple block for inguinal hernia repair or orchidopexy

Anatomy

- The ilioinguinal and iliohypogastric nerves pass through the external and internal oblique muscle layers of the anterior abdominal wall



Technique

- Usually performed under general anaesthesia
- With the patient lying on their back, expose and identify the anterior superior iliac spine (ASIS) on the correct side
- Clean the skin with antiseptic solution
- The needle insertion point is located **one patient finger breadth medial and inferior** to the ASIS (see diagram) – avoid the groin skin crease as this will be the surgical incision site
- Blunt the tip of a 22G or 23G needle and insert the needle perpendicular to the skin at this point
- After passing through the skin, advance needle until a “pop” is felt as the needle punctures the external oblique muscle
- Aspirate to ensure the needle is not in a blood vessel
- Inject local anaesthetic, saving approximately 1-2mls
- Inject remaining 1-2mls of local anaesthetic in a subcutaneous fan laterally, medially and inferiorly to needle insertion point

Local anaesthetic dose

- Use a volume of 0.5mls/kg of 0.25% bupivacaine
- For example in a 10kg child, use 5mls of 0.25% bupivacaine

Side effects / risks

- Failed block, intravascular injection, femoral nerve block (this can cause temporary leg weakness)

Burns Fluid Resuscitation

Patients can lose large amounts of fluid following a major burn. Fluid replacement should be anticipated and replaced using the Parkland Formula, which requires an estimation of the body surface area (BSA) of burn (see diagram).

Initial 24 hours

- **Hypovolaemic shock:** IV bolus of 20mls/kg of crystalloid fluid. If more than one fluid bolus required, look for other signs of blood loss (e.g. from trauma)
- **Minor burn (<10% BSA):** oral rehydration may be appropriate but be aware of post-burn ileus, which may decrease absorption
- **Major burn (>10% BSA):** use Parkland Formula to estimate fluid requirement in initial 24 hours after a burn

Parkland Formula:

$$\% \text{ BSA burn} \times \text{Weight} \times 4\text{mls}$$

- Give this is the **first 24 hours:**
 - Give **half the volume in first 8 hours**
 - Give the **remaining half over next 16 hours**

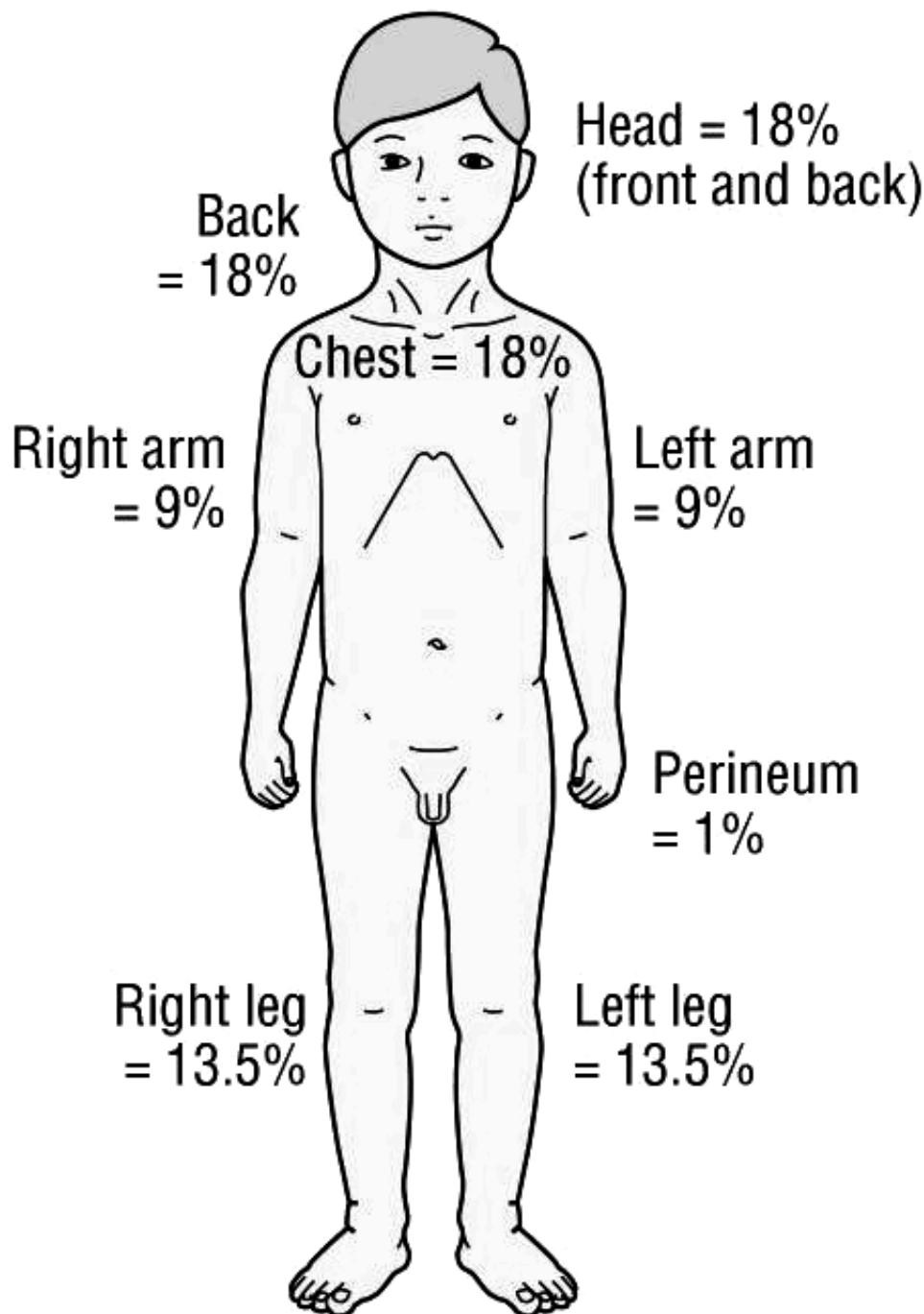
Subsequent days

- 1ml / kg / %BSA burn, per day
- This is only a guide and fluid replacement should be based on clinical findings of hydration status

Baxter CR, Shires T. Physiologic response to crystalloid resuscitation of severe burns.
Ann NY Acad Sci 1968; 150: 874 –93

% Body Surface Area (BSA) estimation

- **Palmar surface:** the surface of the patient's palm (including adducted fingers) is approximately 1% of the patient's BSA
- **Wallace Rule of 9's:** this divides the total BSA into areas of 9%, as shown in the diagram. However, it can overestimate the extent of the burn in young children



Adapted by permission from BMJ Publishing Group Ltd. Initial Management of Major Burn: II
– Assessment and Resuscitation, Hettiarachy S. *BMJ* 2004; 329: 101

Example of Burns Fluid Resuscitation calculation:

A 25kg child with burns to front of chest and abdomen, left arm and left leg

STEP 1	
% BSA burn estimation Using Wallace Rule of Nines diagram: $18 + 9 + 13.5 = 40.5\%$	
STEP 2	
Parkland Formula $\%BSA \text{ burn} \times \text{Weight} \times 4\text{mls}$ $= 40.5\% \times 25\text{kg} \times 4\text{mls}$ $= 4050 \text{ mls (to be given in the first 24 hours)}$	
STEP 3	
Fluids in first 8 hours: $4050\text{mls} / 2 = \mathbf{2025\text{mls}}$ $2025\text{mls} / 8 \text{ (per hour)}$ $= \mathbf{253 \text{ mls/hr}}$	Fluids in next 16 hours: $4050\text{mls} / 2 = \mathbf{2025\text{mls}}$ $2025\text{mls} / 16 \text{ (per hour)}$ $= \mathbf{126 \text{ mls/hr}}$
STEP 4	
Therefore, in first 8 hours, give approximately 250 mls/hr in next 16 hours, give approximately 125 mls/hr	

Choice of fluid:

- Use Ringer's Lactate or 0.9% Saline
- **Do not use** 5% dextrose as replacement fluid

Neonatal Anaesthesia

Special Considerations

Preoperative assessment

- Actual weight and post-conceptual age
- Assess for congenital abnormalities
- Ensure Vitamin K has been given
- Check baseline Hb (normally 16-18 g/dL at birth)

Preparation

- Drug doses calculated and drawn up before induction
- At least 1 unit of blood cross-matched
- Warm theatre and keep baby covered at all times

Intraoperatively

- Use NG tube to decompress abdominal distension
- Keep baby warm (cover head, warm fluid, warming devices)
- Check blood glucose level and treat if $<3\text{mmol/L}$

Analgesia

- Consider local anaesthetic blocks and wound infiltration
- Regular paracetamol, avoid NSAIDs
- Cautious use of opioids (risk of postoperative apnoea)

Postoperative management

- Extubate when fully awake
- Close postoperative monitoring in first 24 hours
- If oxygen is required postoperatively, saturations should be monitored and maintained at 95-98%
- Premature neonates are most at risk of postoperative apnoea

Paediatric Anaesthetic Emergencies

Topics:

- Paediatric Life Support
- Newborn Life Support
- Sick Laparotomy
- Anaphylaxis
- Status Epilepticus
- Local Anaesthetic Toxicity

General principles:

- Use **ABCDE** approach
- Call for **HELP** early
- **WETFLAG** mnemonic is useful to estimate drugs and tube size for a child in an emergency

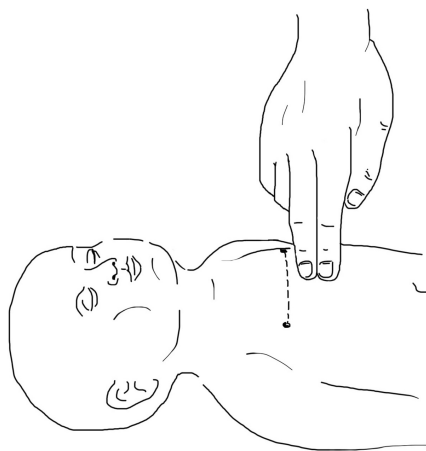
W E T F L A G		
W	Weight (kg)	$(\text{Age} + 4) \times 2$
E	Energy (J) for defibrillation	4 J/kg
T	Tube (mm)	$(\text{Age} / 4) + 4.5$
FI	Fluid bolus (ml)	20 mls/kg
A	Adrenaline (mcg)	10 mcg/kg 0.1mls/kg of 1:10,000
G	Glucose 10% solution (mls)	2 mls/kg

Paediatric Life Support

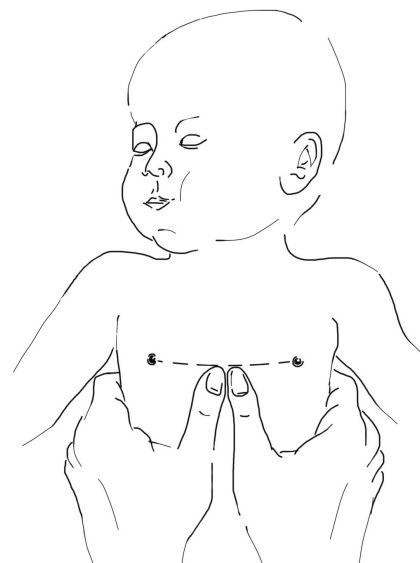
Key Points

- The most common cause of paediatric cardiac arrest is **hypoxia**
- **Effective oxygen delivery** is the critical step in resuscitation
- Once cardiac arrest is recognized, **start CPR immediately**
- Ensure effective compressions: Push **HARD, FAST** and allow **RECOIL**
- Depth of compression is one third of anterior-posterior depth of chest and rate is 100 compressions per minute
- Minimise interruptions to CPR
- If **defibrillator is available**, attach early and assess rhythm (page 23)

Chest compression techniques



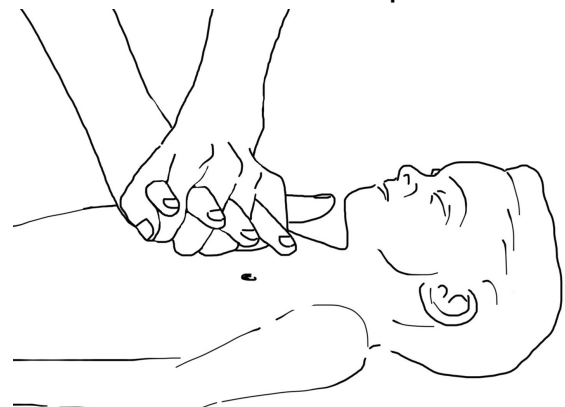
Two finger technique



Two thumb technique



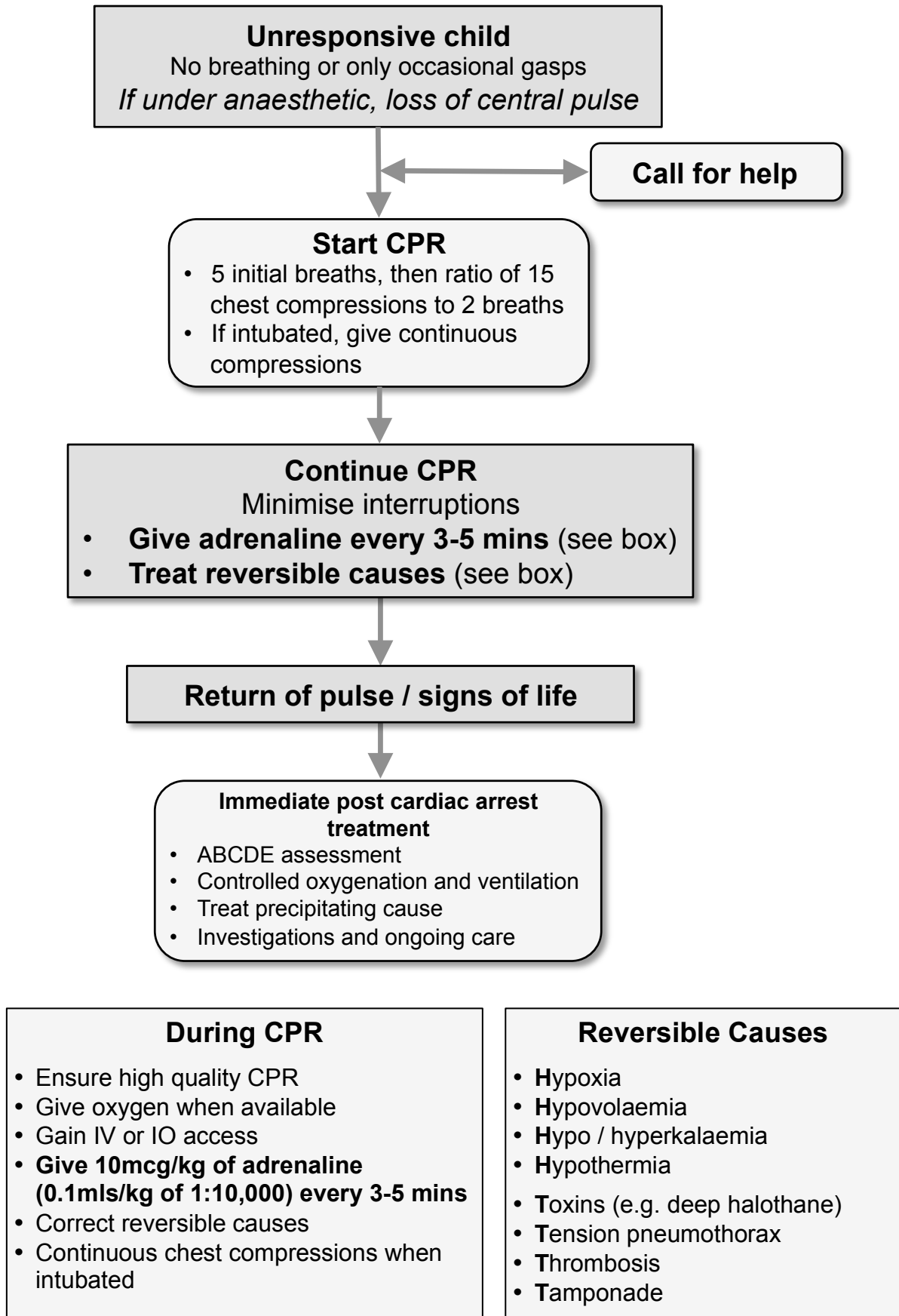
One hand technique



Two hand technique

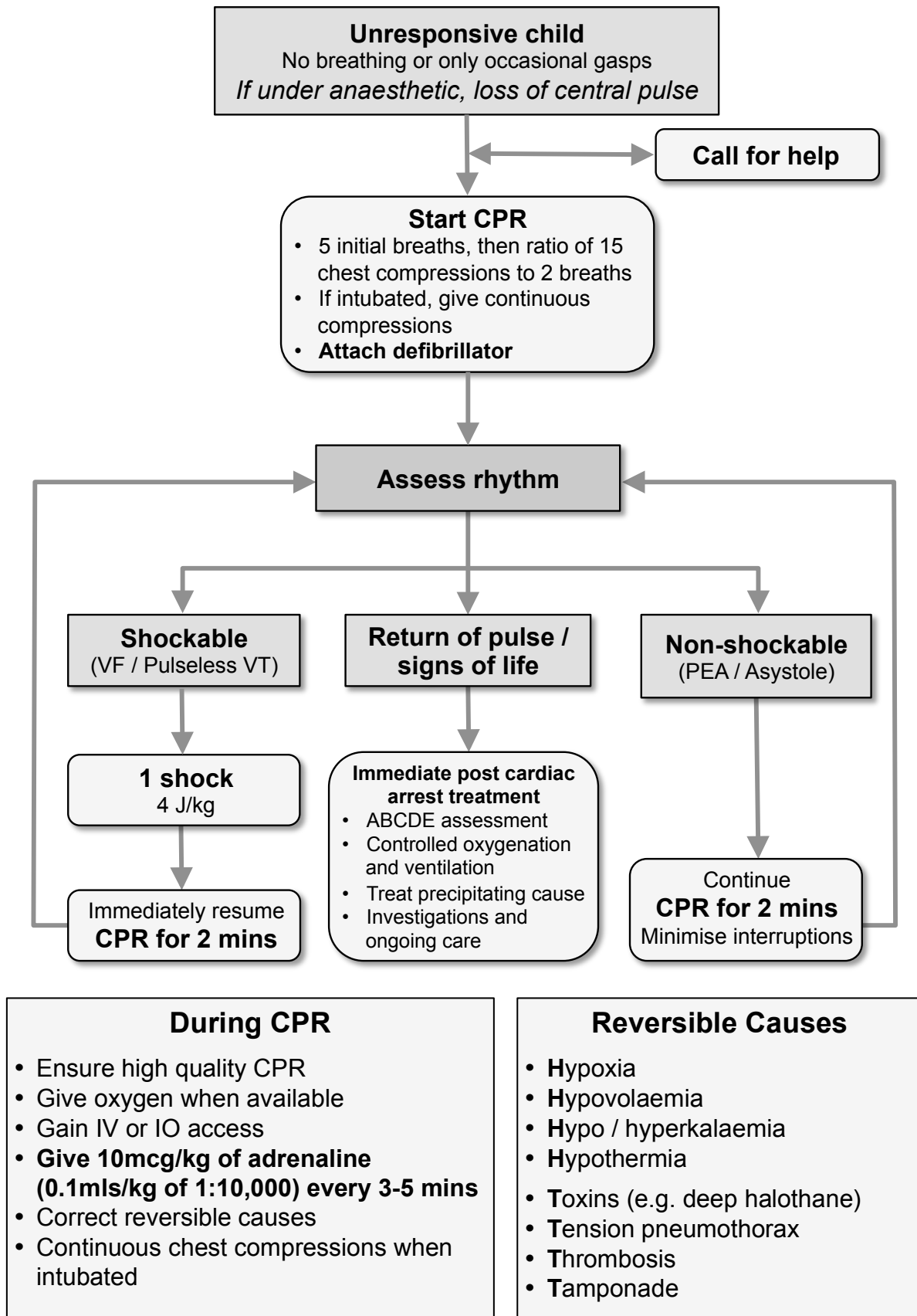
Paediatric Life Support

(Defibrillator *not* available)



Paediatric Life Support

(Defibrillator available)



VF- Ventricular fibrillation; VT- Ventricular tachycardia; PEA- Pulseless electrical activity

Newborn Life Support

Key Points

- The most important task of newborn resuscitation is to **HELP THE BABY BREATHE**
- If there is thick meconium and no respiratory effort, suction the airway but **DO NOT DELAY RESCUE BREATHS**
- There is little benefit in starting chest compressions if airway is not open and the lungs are not inflated
- Start chest compressions **if heart rate is <60** beats per minute
- Resuscitation attempts should be stopped if there is no heart beat after 20 minutes

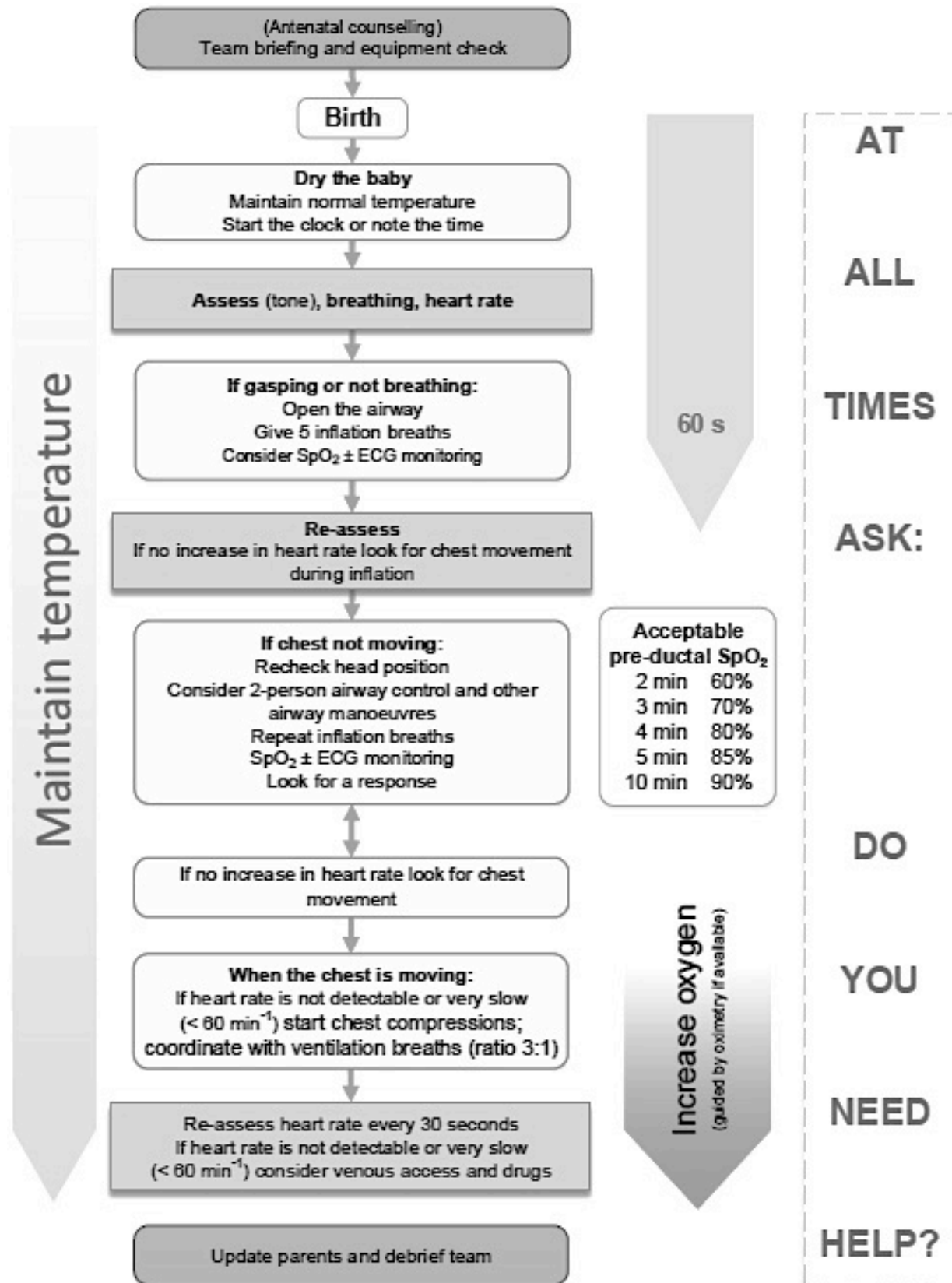
APGAR scoring

- The APGAR score should be performed at **one and five minutes** after delivery, to indicate the overall status of the baby
- APGAR scoring **should not delay resuscitation**
- A score of above 7 at one minute is normal
- A score of 3 is critically low
- A score of below 7 at 5 minutes is low and indicates the baby may need ongoing resuscitation and observation

APGAR SCORING			
	Score 0	Score 1	Score 2
Activity	Floppy	Limbs flexed	Active
Pulse rate	<60	60 - 100	>100
Grimace (Response to stimulation)	No response	Grimace only	Sneezes, coughs or move away
Appearance (colour)	Pale or blue all over	Pink centrally with blue hands / feet	Pink all over
Respiration	No breathing	Irregular breathing	Regular breathing

Apgar V. A proposal for a new method of evaluation of the newborn infant.
Curr Res Anesth Analg 1953; 32 (4): 260-7

Newborn Life Support



Sick Laparotomy

Signs and symptoms of intra-abdominal sepsis

- Fever $>38^{\circ}\text{C}$, high respiratory rate, high heart rate, low BP
- Oliguria, altered conscious level, acute abdomen

Give high flow oxygen

Fluid resuscitation

- **IV access:** 2 x 20G cannulae
- **Blood investigations:** FBC, U&Es, clotting, blood cultures, cross match and **glucose**
- **Give IV fluids:** 20ml/kg of normal saline and assess response

If starting Hb is below 7g/dl, cross match and transfuse blood at the earliest time possible

IV antibiotics: give within 1 hour of diagnosis

Ciprofloxacin (10 mg/kg; max 400mg)

or ceftriaxone (50 mg/kg; max 4g)

Plus metronidazole (7.5 mg/kg; max 500mg)

Plus gentamicin (7 mg/kg once daily dose; max 500mg)

Analgesia

- Treat according to severity of pain
- Avoid NSAIDs and IM injections

Insert NG tube and urinary catheter

Definitive management: Surgery

- Make sure blood available before starting
- RSI with ketamine. Avoid deep halothane.

Post-operative care

- High dependency care unit
- Continue antibiotics for 5 days. Give regular analgesia

Anaphylaxis

Diagnosis

- Signs include stridor, wheeze, desaturation, hypotension, tachycardia, rash and airway oedema
- May be associated with common triggers (e.g. antibiotics, muscle relaxants, latex gloves)

Immediate management

- **ABC approach**
- **Call for help**
- **Stop administering any potential triggers** (e.g. antibiotics)
- **Give intramuscular (IM) adrenaline** as early as possible:

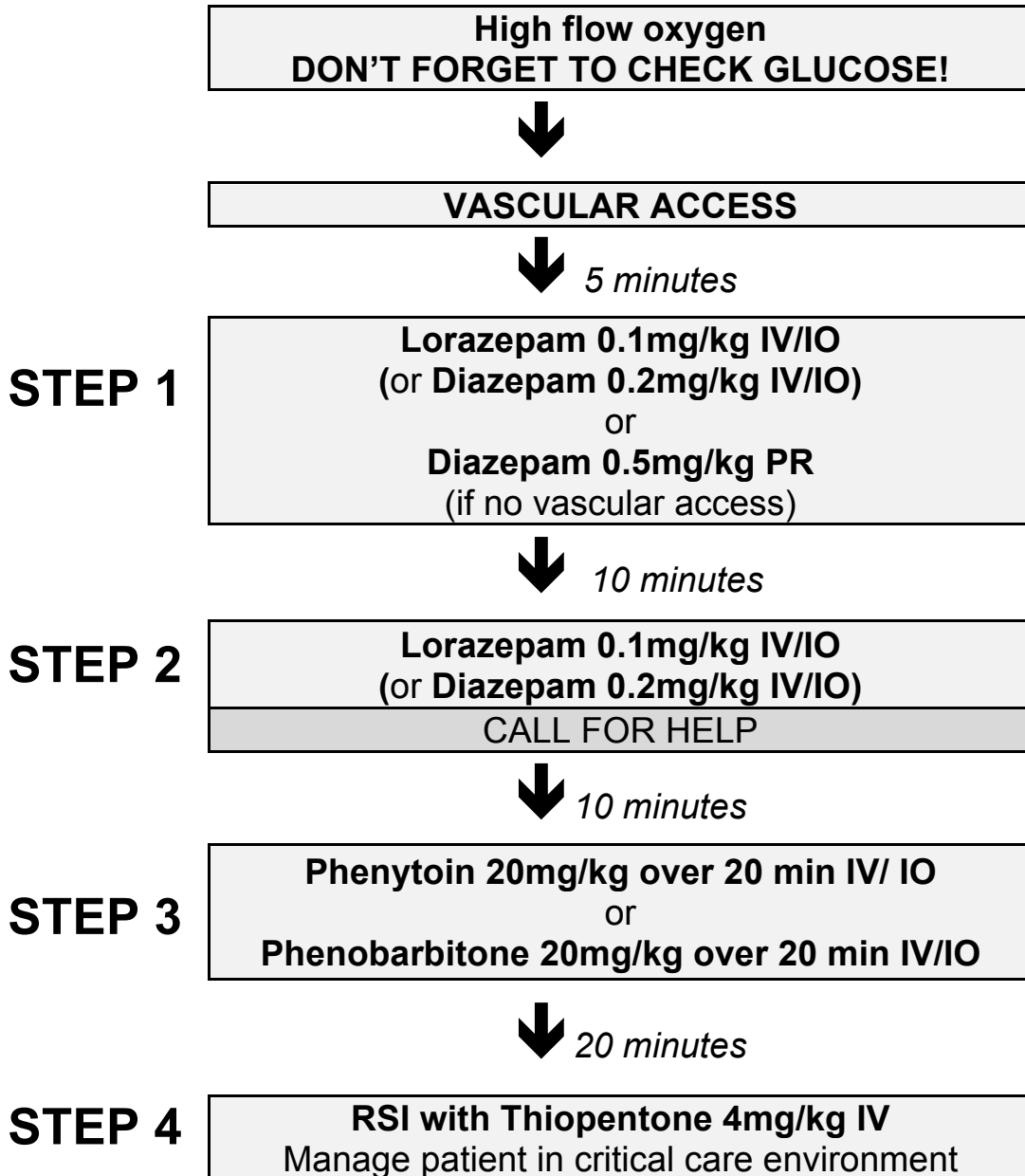
Adrenaline dose for anaphylaxis

Child under 6 years	150mcgs IM (0.15mls of 1:1000 adrenaline)
Child 6-12 years	300mcgs IM (0.3mls of 1:1000 adrenaline)
Child over 12 years	500mcgs IM (0.5mls of 1:1000 adrenaline)

- Give **high flow oxygen**
- Give **IV fluid resuscitation** (20ml/kg bolus)
- Give **hydrocortisone IV** and consider giving an **antihistamine** (such as chlorphenamine) if available – see table
- Monitor heart rate, blood pressure and oxygen saturation
- May need further boluses of IV fluid if hypotensive
- Adrenaline dose may be repeated after 5 minutes if needed

	Hydrocortisone (IM or slow IV)	Chlorphenamine (IM or slow IV)
Child under 6 months	25mg	250mcg/kg
6 months - 6 years	50mg	2.5mg
6 -12 years	100mg	5mg
Child over 12 years	200mg	10mg

Status Epilepticus



Local Anaesthetic Toxicity

1 Recognition	Signs of toxicity: <ul style="list-style-type: none"> • Neurological: Agitation, alteration in mental state, loss of consciousness, convulsions • Cardiac: Arrhythmias, cardiac arrest 	
2 Immediate management	<ul style="list-style-type: none"> • Stop injecting local anaesthetic • Call for help • Maintain airway (<u>may</u> need intubation) • High flow oxygen (give ventilation if required) • Control seizures: give benzodiazepine or thiopentone in small incremental doses • Assess cardiovascular status throughout 	
3 Treatment	In circulatory arrest: <ul style="list-style-type: none"> • Start cardio-pulmonary resuscitation (CPR) • Arrhythmias may be very resistant, may need prolonged resuscitation (>1hr) • Give IV lipid emulsion* 	Without circulatory arrest: <ul style="list-style-type: none"> • Treat arrhythmias and blood pressure as required • Consider IV lipid emulsion*
4 Follow-up	<ul style="list-style-type: none"> • Monitor patient closely until sustained recovery • Document all events in patient notes 	

* **IV lipid emulsion**, if available:

- **Initial bolus:** 1.5 mls/kg of 20% lipid solution
- **Followed by infusion:** 15 mls/kg/hr of 20% lipid solution
- **If no improvement, give up to two further boluses** (1.5mls/kg every 5 minutes) **and double the infusion rate** (30mls/kg/hr)
- Propofol is not a suitable alternative to lipid emulsion

Pre-calculated Equipment and Drugs Table

1 month old Estimated Weight = 4 kg

Airway	ETT size	3.0 – 3.5
	ETT length	10 – 10.5 cm
	LMA size	-
Fluids	Estimated blood volume	320 mls
	Fluid bolus (20mls/kg)	80 mls
	Whole blood bolus (8mls/kg)	32 mls
	Packed cells bolus (5mls/kg)	20 mls
	10% glucose (2mls/kg)	8 mls
	Hourly maintenance fluid	16 mls/hr
Drug doses	Adrenaline (in cardiac arrest)	40 mcg IV (0.4 mls of 1:10,000)
	Amoxicillin	120 mg
	Atracurium	2 mg
	Atropine	80 mcg
	Ceftriaxone	200 mg
	Diclofenac	-
	Fentanyl	4 – 8 mcg
	Gentamicin	8mg (surgical prophylaxis)
	Ketamine	4 – 8 mg IV
	Metronidazole	30 mg
	Morphine	0.08 – 0.4 mg IV
	Neostigmine	0.2 mg
	Paracetamol	80 mg PR
	Pethidine	-
	Propofol	8 - 20 mg
	Suxamethonium	8 mg IV
	Thiopentone	8 – 16 mg
LAs	2% Lignocaine (max. dose)	0.6 ml (without adrenaline) 1.4 mls (with adrenaline)
	0.25% Bupivacaine (max. dose)	3.2 mls

Pre-calculated Equipment and Drugs Table

6 month old Estimated Weight = **7 kg**

Airway	ETT size	3.5 – 4.0
	ETT length	11.5 – 12.5 cm
	LMA size	1
Fluids	Estimated blood volume	560 mls
	Fluid bolus (20mls/kg)	140 mls
	Whole blood bolus (8mls/kg)	56 mls
	Packed cells bolus (5mls/kg)	35 mls
	10% glucose (2mls/kg)	14 mls
	Hourly maintenance fluid	28 mls/hr
Drug doses	Adrenaline (in cardiac arrest)	70 mcg IV (0.7 mls of 1:10,000)
	Amoxicillin	210 mg
	Atracurium	3.5 mg
	Atropine	140 mcg
	Ceftriaxone	350 mg
	Diclofenac	-
	Fentanyl	7 – 14 mcg
	Gentamicin	14mg (surgical prophylaxis)
	Ketamine	7 – 14 mg IV
	Metronidazole	52 mg
	Morphine	0.14 – 0.7 mg IV
	Neostigmine	0.35 mg
	Paracetamol	140 mg PR
	Pethidine	-
	Propofol	14 - 35 mg
	Suxamethonium	14 mg IV
	Thiopentone	14 – 28 mg
LAs	2% Lignocaine (max. dose)	1.0 ml (without adrenaline) 2.5 mls (with adrenaline)
	0.25% Bupivacaine (max. dose)	5.6 mls

Pre-calculated Equipment and Drugs Table

1 year old Estimated Weight = 10 kg

Airway	ETT size	4.0 – 4.5
	ETT length	12 – 13 cm
	LMA size	1½
Fluids	Estimated blood volume	800 mls
	Fluid bolus (20mls/kg)	200 mls
	Whole blood bolus (8mls/kg)	80 mls
	Packed cells bolus (5mls/kg)	50 mls
	10% glucose (2mls/kg)	20 mls
	Hourly maintenance fluid	40 mls/hr
Drug doses	Adrenaline (in cardiac arrest)	100 mcg IV (1 mls of 1:10,000)
	Amoxicillin	300 mg
	Atracurium	5 mg
	Atropine	200 mcg
	Ceftriaxone	500 mg
	Diclofenac	5mg IV or 10mg PR
	Fentanyl	10 – 20 mcg
	Gentamicin	20mg (surgical prophylaxis)
	Ketamine	10 – 20 mg IV
	Metronidazole	75 mg
	Morphine	0.5 – 1 mg IV
	Neostigmine	0.5 mg
	Paracetamol	200 mg PR
	Pethidine	5 – 10 mg
	Propofol	20 – 50 mg
	Suxamethonium	20 mg IV
	Thiopentone	20 – 40 mg
LAs	2% Lignocaine (max. dose)	1.5 mls (without adrenaline) 3.5 mls (with adrenaline)
	0.25% Bupivacaine (max. dose)	8 mls

Pre-calculated Equipment and Drugs Table

3 year old Estimated Weight = 14 kg

Airway	ETT size	5.0
	ETT length	13 – 14 cm
	LMA size	2
Fluids	Estimated blood volume	1100 mls
	Fluid bolus (20mls/kg)	280 mls
	Whole blood bolus (8mls/kg)	112 mls
	Packed cells bolus (5mls/kg)	70 mls
	10% glucose (2mls/kg)	28 mls
	Hourly maintenance fluid	48 mls/hr
Drug doses	Adrenaline (in cardiac arrest)	140 mcg IV (1.4 mls of 1:10,000)
	Amoxicillin	420 mg
	Atracurium	7 mg
	Atropine	280 mcg
	Ceftriaxone	700 mg
	Diclofenac	7mg IV or 14mg PR
	Fentanyl	14 – 28 mcg
	Gentamicin	28mg (surgical prophylaxis)
	Ketamine	14 – 28 mg IV
	Metronidazole	105 mg
	Morphine	0.7 – 1.4 mg IV
	Neostigmine	0.7 mg
	Paracetamol	280 mg PR
	Pethidine	7 – 14 mg
	Propofol	28 - 70 mg
	Suxamethonium	28 mg IV
	Thiopentone	28 – 56 mg
LAs	2% Lignocaine (max. dose)	2.1 mls (without adrenaline) 4.9 mls (with adrenaline)
	0.25% Bupivacaine (max. dose)	11.2 mls

Pre-calculated Equipment and Drugs Table

6 year old Estimated Weight = 20 kg

Airway	ETT size	6.0
	ETT length	14 – 16 cm
	LMA size	2 or 2½
Fluids	Estimated blood volume	1600 mls
	Fluid bolus (20mls/kg)	240 mls
	Whole blood bolus (8mls/kg)	160 mls
	Packed cells bolus (5mls/kg)	100 mls
	10% glucose (2mls/kg)	40 mls
	Hourly maintenance fluid	60 mls/hr
Drug doses	Adrenaline (in cardiac arrest)	200 mcg IV (2 mls of 1:10,000)
	Amoxicillin	600 mg
	Atracurium	10 mg
	Atropine	400 mcg
	Ceftriaxone	1 g
	Diclofenac	10mg IV or 20mg PR
	Fentanyl	20 – 40 mcg
	Gentamicin	40mg (surgical prophylaxis)
	Ketamine	20 – 40 mg IV
	Metronidazole	150 mg
	Morphine	1 – 2 mg IV
	Neostigmine	1 mg
	Paracetamol	400 mg PR
	Pethidine	10 – 20 mg
	Propofol	40 - 100 mg
	Suxamethonium	40 mg IV
	Thiopentone	40 – 80 mg
LAs	2% Lignocaine (max. dose)	3 mls (without adrenaline) 7 mls (with adrenaline)
	0.25% Bupivacaine (max. dose)	16 mls

Pre-calculated Equipment and Drugs Table

8 year old Estimated Weight = 25 kg

Airway	ETT size	6.5
	ETT length	15 – 17 cm
	LMA size	2½
Fluids	Estimated blood volume	2000 mls
	Fluid bolus (20mls/kg)	500 mls
	Whole blood bolus (8mls/kg)	200 mls
	Packed cells bolus (5mls/kg)	125 mls
	10% glucose (2mls/kg)	50 mls
	Hourly maintenance fluid	65 mls/hr
Drug doses	Adrenaline (in cardiac arrest)	250 mcg IV (2.5 mls of 1:10,000)
	Amoxicillin	750 mg
	Atracurium	12.5 mg
	Atropine	500 mcg
	Ceftriaxone	1.2 g
	Diclofenac	12.5mg IV or 25mg PR
	Fentanyl	25 – 50 mcg
	Gentamicin	50mg (surgical prophylaxis)
	Ketamine	25 – 50 mg IV
	Metronidazole	188 mg
	Morphine	1.25 – 2.5 mg IV
	Neostigmine	1.2 mg
	Paracetamol	500 mg PR
	Pethidine	12 – 25 mg
	Propofol	50 – 125 mg
	Suxamethonium	50 mg IV
	Thiopentone	50 – 100 mg
LAs	2% Lignocaine (max. dose)	3.8 mls (without adrenaline) 8.8 mls (with adrenaline)
	0.25% Bupivacaine (max. dose)	20 mls

Pre-calculated Equipment and Drugs Table

10 year old

Estimated Weight = 30kg

Airway	ETT size	7.0
	ETT length	16 – 18 cm
	LMA size	2½ or 3
Fluids	Estimated blood volume	2400 mls
	Fluid bolus (20mls/kg)	600 mls
	Whole blood bolus (8mls/kg)	240 mls
	Packed cells bolus (5mls/kg)	150 mls
	10% glucose (2mls/kg)	60 mls
	Hourly maintenance fluid	70 mls/hr
Drug doses	Adrenaline (in cardiac arrest)	300 mcg IV (3 mls of 1:10,000)
	Amoxicillin	900 mg
	Atracurium	15 mg
	Atropine	600 mcg
	Ceftriaxone	1.5 g
	Diclofenac	15mg IV or 30mg PR
	Fentanyl	30 – 60 mcg
	Gentamicin	60mg (surgical prophylaxis)
	Ketamine	30 – 60 mg IV
	Metronidazole	225 mg
	Morphine	1.5 – 3 mg IV
	Neostigmine	1.5 mg
	Paracetamol	600 mg PR
	Pethidine	15 – 30 mg
	Propofol	60 – 150 mg
	Suxamethonium	60 mg IV
	Thiopentone	60 – 120 mg
LAs	2% Lignocaine (max. dose)	4.5 mls (without adrenaline) 10.5 mls (with adrenaline)
	0.25% Bupivacaine (max. dose)	24 mls

Obstetric Anaesthesia

Physiological changes in pregnancy

Cardiovascular system	<ul style="list-style-type: none"> • Increase in blood volume (50% increase) • Increase in red cell mass (30% increase) • Physiological anaemia of pregnancy (10-20% decrease in Hb concentration) • Increase in cardiac output (50% increase) • Aortocaval compression, most marked when mother is lying flat on back • Hyper-coagulable state after 1st trimester
Respiratory system	<ul style="list-style-type: none"> • Swelling of airway soft tissues which can make intubation more difficult • Increase in minute ventilation leading to respiratory alkalosis • Increase in oxygen consumption (25% increase) making the mother more susceptible to hypoxia • Upward displacement of diaphragm by uterus leading to reduced functional residual capacity (FRC) and total lung capacity (TLC)
Gastrointestinal system	<ul style="list-style-type: none"> • Slower gastric emptying during labour which increases risk of reflux and regurgitation • Increased risk of aspiration under general anaesthesia
Renal system	<ul style="list-style-type: none"> • Increase in renal blood flow • Fall in urea and creatinine levels

Preoperative assessment

- All patients requiring anaesthetic intervention need a preoperative assessment and should be seen at the earliest time possible
- This allows identification of high risk mothers and planning of patient's care
- The following should be taken as a minimum:

History

Establish indication and degree of urgency for surgery (see page 42)

Past medical history

- Cardiovascular: congenital heart disease, arrhythmia
- Respiratory: severe asthma, tuberculosis
- Central nervous system: epilepsy
- Endocrine: diabetes
- Infectious disease: HIV, hepatitis

Obstetric history

- Gravida parity
- Pregnancy induced conditions (e.g. PET, gestational diabetes)
- Problems with previous deliveries

Anaesthetic history

- Family history (e.g. suxamethonium apnoea, malignant hyperthermia)
- Problems with previous epidural or spinal anaesthesia
- History of difficult airway

Medications

- Regular medications
- Medication given during labour
- Is the patient on any anticoagulation?

Allergies

Fasting status

Examination

Airway and breathing

- Respiratory rate, breath sounds, oxygen saturations
- Careful airway assessment helps to predict for difficult intubation (page 41)

Circulation

- Heart rate and blood pressure
- Signs of anaemia

Spine and Weight

- Inspect for spinal deformities. Are landmarks easily palpable?
- Obesity is associated with difficult venous access, difficult intubation and difficult spinal anaesthesia

Investigations

Ensure FBC and Group & Save are performed prior to surgery

In PET- need platelet count within last 4 hours before spinal anaesthesia; check renal function, electrolytes and clotting

Explanation and Consent

Obtain consent prior to any GA or spinal anaesthesia

Discuss risks associated with spinal anaesthesia

- Low blood pressure; failure for spinal to work (common)
- Headache (uncommon)
- Nerve damage (rare)
- Infection (very rare)

Discuss risks associated with GA

- Sore throat; nausea (common)
- Failed intubation; awareness (uncommon)
- Damage to teeth (rare)
- Anaphylaxis (very rare)

Predictors for difficult intubation

- Mallampati 3-4
- Mouth opening <3 fingers
- Neck flexion/extension <90°
- Inability to protrude lower jaw beyond upper incisors
- Thyromental distance <7cm
- Obesity
- PET- associated with laryngeal oedema

Risk of failed intubation is 10 times higher in the obstetric population

If you suspect a difficult airway, get help and prepare for possible failed intubation (page 52)

Measures to reduce aspiration risk in pregnant women

- Starve patient 6 hours prior to elective surgery
- Ranitidine 150mg PO QDS during labour
- Sodium citrate 30ml of 0.3molar solution just before pre-oxygenation

Urgency of Caesarean Section

Key points:

- Timing depends on the indication for surgery and the condition of the mother and fetus
- Good communication with obstetric team is vital
- Regardless of urgency, ensure mother's condition is stabilised as much as possible before surgery

Emergency: Immediate threat to the life of the mother or fetus	
Timing:	As soon as possible, ideally within 30 minutes
Examples:	<ul style="list-style-type: none"> • Prolonged fetal bradycardia secondary to abruption • Severe APH from bleeding placenta praevia • Severe fetal distress associated with cord prolapse • Uterine rupture
Urgent: Maternal or fetal compromise NOT immediately life threatening	
Timing:	Promptly after decision has been made, once mother's condition has been optimised
Examples:	<ul style="list-style-type: none"> • Malpresentation (face or brow) • Failure to progress, with thick meconium • Severe PET where vaginal delivery is not possible → need to control hypertension first
Scheduled: No maternal or fetal compromise but needs early delivery	
Timing:	Early but when safe to do so
Examples:	<ul style="list-style-type: none"> • Failed induction of labour • Breech presentation in early labour • Macrosomic baby in early labour
Elective	
Timing:	Delivery at time to suit the mother and maternity services
Examples:	<ul style="list-style-type: none"> • Twin pregnancy, first fetus is breech presentation • Two or more previous caesarean sections • HIV positive • Herpes simplex infection of vagina

Spinal Anaesthesia

Spinal anaesthesia is the method of choice for most caesarean sections, providing there are no contraindications

Contra-indications:

- Maternal refusal
- Untrained anaesthetic provider
- Skin infection at needle injection site
- Severe maternal sepsis
- Poor clotting function (INR > 1.5 or platelets < 80x10⁹/L)
- Severe aortic or mitral valve stenosis

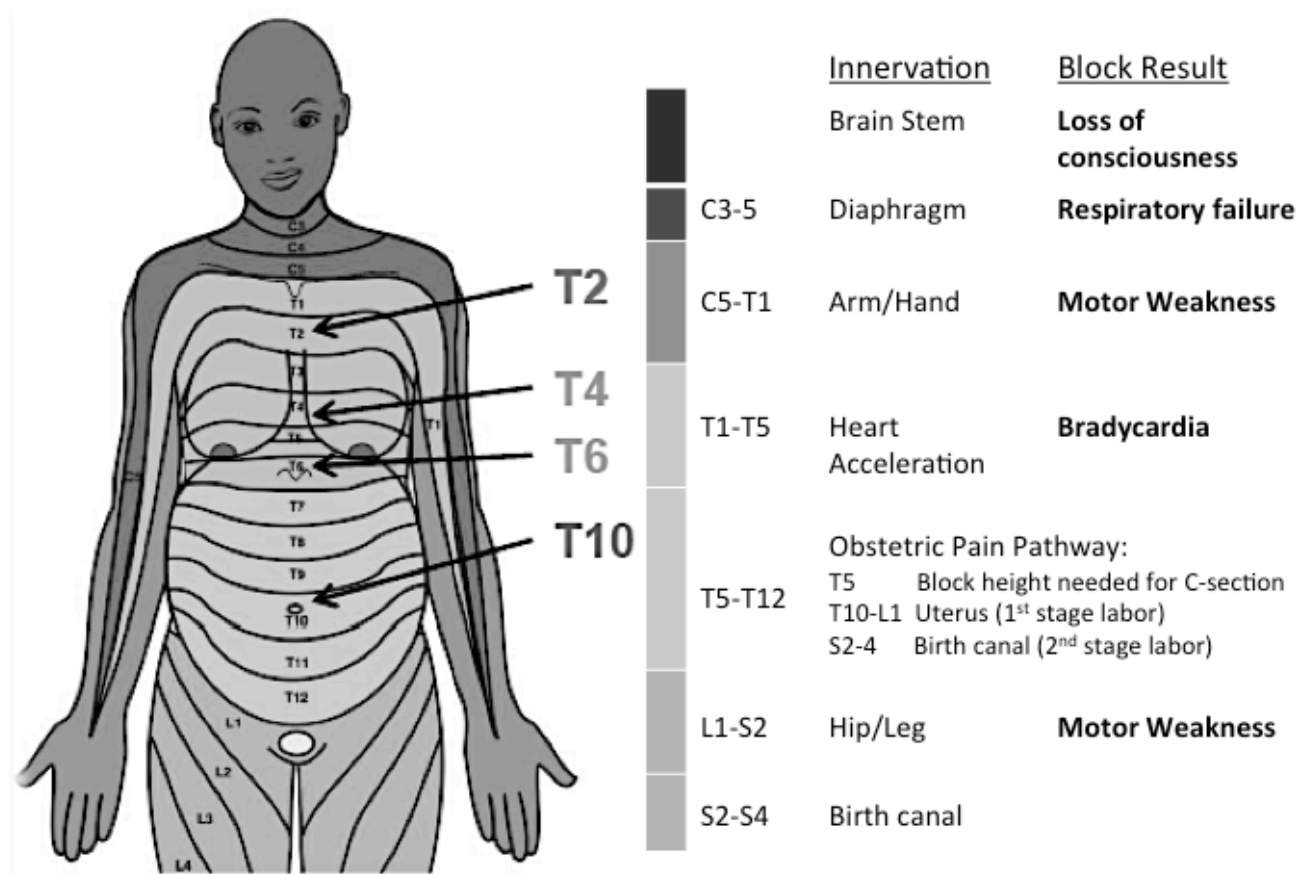
Preparation:

- Obtain **consent** from patient
- Complete '**Pre-anaesthetic checklist**' (page 67)
- Ensure vasoconstrictors and all equipment for general anaesthesia are immediately available
- **Monitor saturations and BP** before and during procedure
- Ensure large bore intravenous access
- Consider preloading patients with intravenous crystalloid (10-15ml/kg) especially if **bleeding, septic or dehydrated**
- **Note: Avoid preloading in pre-eclampsia**

Technique:

- Ensure **strict asepsis**
- Spinal should be performed at **L3/4 or L4/5** levels
- Ideally, use **25G or smaller** pencil point spinal needle
- Do not inject spinal solution if patient complains of pain radiating to back, legs or bottom
- Only use preservative free local anaesthetic
- Bupivacaine is preferable to lidocaine
- Minimum height of block required for caesarean section is **T5**
- Ensure **antibiotics** are given prior to surgical incision
- Ensure **left lateral tilt** of table or wedge patient's right hip
- Give **5-10iu oxytocin IV** at delivery. If there are risk factors for uterine atony, follow this with an infusion of 40iu in 500ml normal saline over 4 hours

Dermatomes and important innervations



Adapted by permission from © The ESMOE Anaesthesia Working Group

Spinal Anaesthetic Dose

Local Anaesthetic (preservative free)	Concentration	Volume	Duration of block
<i>Heavy Bupivacaine</i>	0.5%	2.0-2.5ml	2-3 hours
<i>Plain Bupivacaine</i>	0.5%	1.8-2.0ml	2-3 hours
<i>Lidocaine</i>	2%	3-4ml	30-45min
<i>Lidocaine</i>	5%	1.0-1.5ml	60-90min

Common problems with spinal anaesthesia

Problem	Management
Failed spinal anaesthesia	No block <ul style="list-style-type: none"> a repeat spinal may be performed
	'Patchy'/ inadequate block before surgery <ul style="list-style-type: none"> Repeat spinal may be performed but beware of high spinal or worsening haemodynamic status
	Intraoperative inadequate block <ul style="list-style-type: none"> Inhaled nitrous oxide (if available) IV opioid (e.g. 25mcg fentanyl). Inform midwife as baby at risk of respiratory depression IV Ketamine (0.2-0.5mg/kg) Surgical infiltration of local anaesthetic Convert to GA if above measures fail
Hypotension	<ul style="list-style-type: none"> Ensure wedge or increase left lateral tilt Intravenous fluid 250ml bolus Avoid head down position after giving heavy bupivacaine Vasoactive medication may be required <ul style="list-style-type: none"> Ephedrine (3-6mg IV bolus) Phenylephrine (50-100mcg IV bolus) Metaraminol (0.5mg IV bolus) Atropine for bradycardia (0.3mg IV bolus) Cautious dosing in pre-eclamptic patients
High spinal	See page 53
LA toxicity	See page 29
Post-dural puncture headache	<ul style="list-style-type: none"> Minimise risk by using pencil point needle 25G or smaller Exclude other serious causes of headache Avoid dehydration and ensure regular analgesia Epidural blood patch should only be performed by an experienced practitioner

General Anaesthesia for Caesarean Section

Indications for General Anaesthesia

- **Maternal request**
- **Failed regional anaesthesia**
- **Urgency of surgery** - many guidelines recommend a GA for emergency caesarean section because it is often quicker. However, the decision will depend on the situation, the patient and the anaesthetist's preference
- **Maternal instability** - this is often a difficult decision and depends on the severity of the maternal condition and the anaesthetist's preference
- **Contra-indication to regional anaesthesia** (see page 43)

Preparation

- **Pre-assess** and **consent** patient
- Give **antacid medication**, if available
- Complete '**Pre-anaesthetic checklist**' (page 67)
- **Monitor saturations and BP** before and during procedure
- **Large bore IV access** with fluid infusion running
- Use **left lateral tilt**
- Position head in **optimal position for intubation** and plan for **potentially difficult intubation**



Ramp obese patients to optimise laryngoscopy view.
Note the ear is level with the sternal notch.

Technique

- **Pre-oxygenate mother** for 3 minutes
- Use **Rapid Sequence Induction (RSI)**
- **Suxamethonium** is advised as muscle relaxation at induction
- All opioids and anaesthetic drugs can be transmitted to the baby before delivery – **inform midwife as baby at risk of respiratory depression**
- Give **antibiotics** before knife to skin
- Deep halothane can contribute to uterine atony
- Give **5-10iu oxytocin IV** at delivery. If there are risk factors for uterine atony, follow this with an infusion of 40iu in 500ml normal saline over 4 hours.
- Extubate mother **fully awake** to avoid aspiration

Postoperative Pain Management

Key Points

- Caesarean sections are painful post-operatively
- All patients should be offered analgesia
- Pain is associated with worse outcomes, including a delay to mobilise, poor coughing, increased risk of chest infections and a longer hospital stay
- Use the WHO analgesic ladder to treat pain (see page 12)
- Most analgesics are safe to give while breastfeeding, but use opioids with caution as they can be transmitted to the baby in breast milk, making the baby more drowsy
- NSAIDs are very effective and reduce opioid requirements. They should be given regularly with paracetamol unless contraindicated
- Contraindications to NSAIDs: pre-eclampsia, renal impairment, thrombocytopaenia, significant haemorrhage, asthmatics sensitive to NSAIDs

Example analgesic regime after caesarean section

Mild Pain

- Paracetamol 1g every 6 hours
- Combine NSAID (e.g. Diclofenac 50mg 8 hourly) if no contraindications

Moderate Pain

- As with mild pain PLUS:
- Tramadol 50-100mg 6 hourly

Severe Pain

- As with mild pain PLUS:
- Oral morphine 10-20mg every 2 hours, as required

Obstetric Anaesthetic Emergencies

Topics:

- Maternal Life Support
- Failed Intubation
- High Spinal and Total Spinal
- Major Obstetric Haemorrhage
- Pre-eclampsia and Eclampsia

Maternal Life Support

Key Points

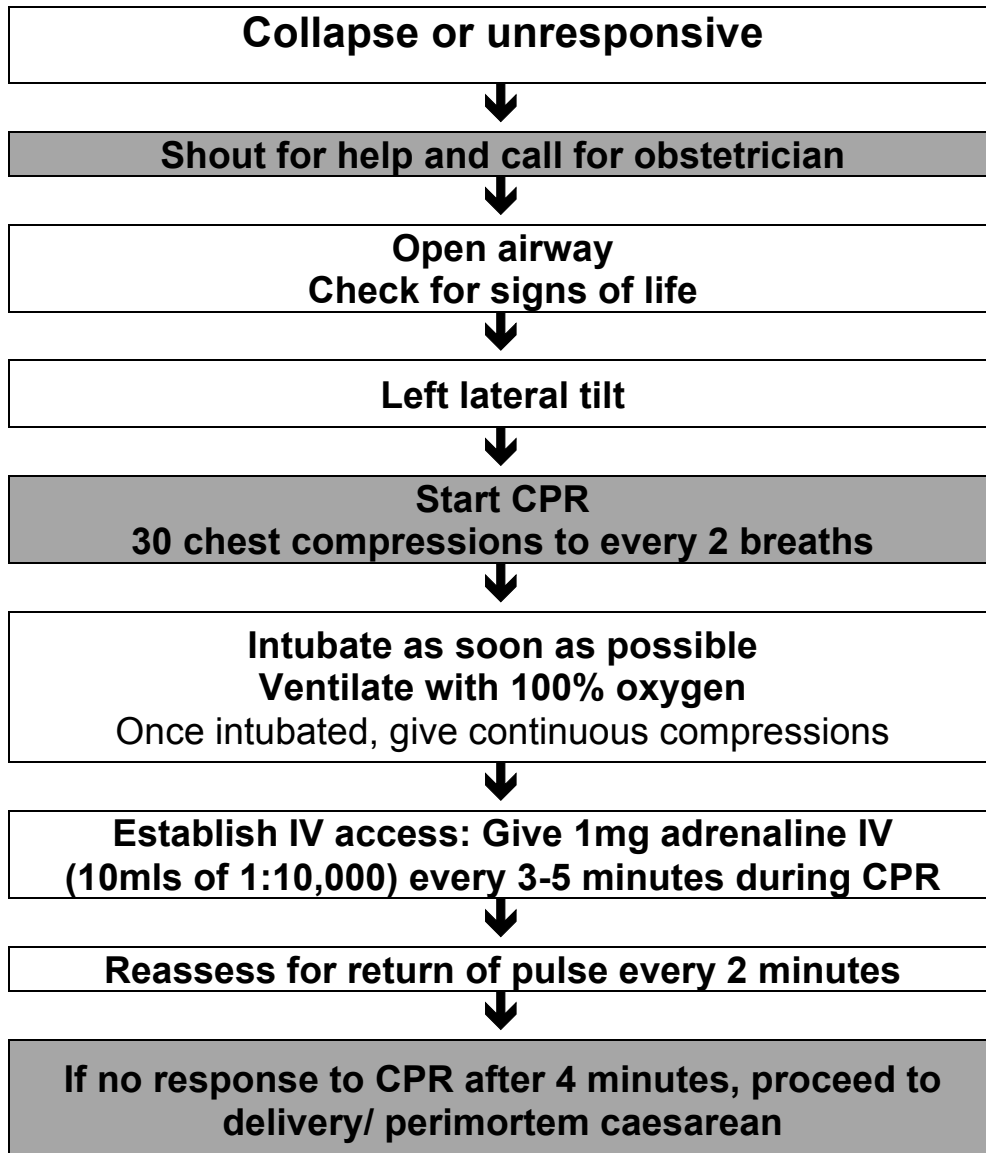
- **Minimise aorto caval compression** - the mother must be tilted to the left. Tilt can be achieved by wedge or pillow under right hip. If not available, get an assistant to kneel and wedge the patient's right hip onto the knees of the assistant
- **Early intubation** is helpful as hypoxia occurs rapidly in pregnant patients
- **Caesarean section should be performed within 5 minutes** if the mother remains in cardiac arrest. This is to improve maternal chances of survival
- A resuscitation team member should be ready to take the baby to provide **neonatal resuscitation**
- If maternal resuscitation is successful, the mother should remain on controlled ventilation and be taken to high dependency or intensive care unit for treatment of precipitating cause

Possible causes of maternal cardiac arrest

Obstetric causes	Non-obstetric causes
<ul style="list-style-type: none"> • Massive haemorrhage • Amniotic fluid embolus • Eclampsia • Peripartum cardiomyopathy 	<ul style="list-style-type: none"> • Pulmonary embolism • Anaphylaxis • Septic shock • Myocardial infarction • Trauma • Intracranial haemorrhage • Anaesthetic complications: LA toxicity, high or total spinal

Maternal Life Support

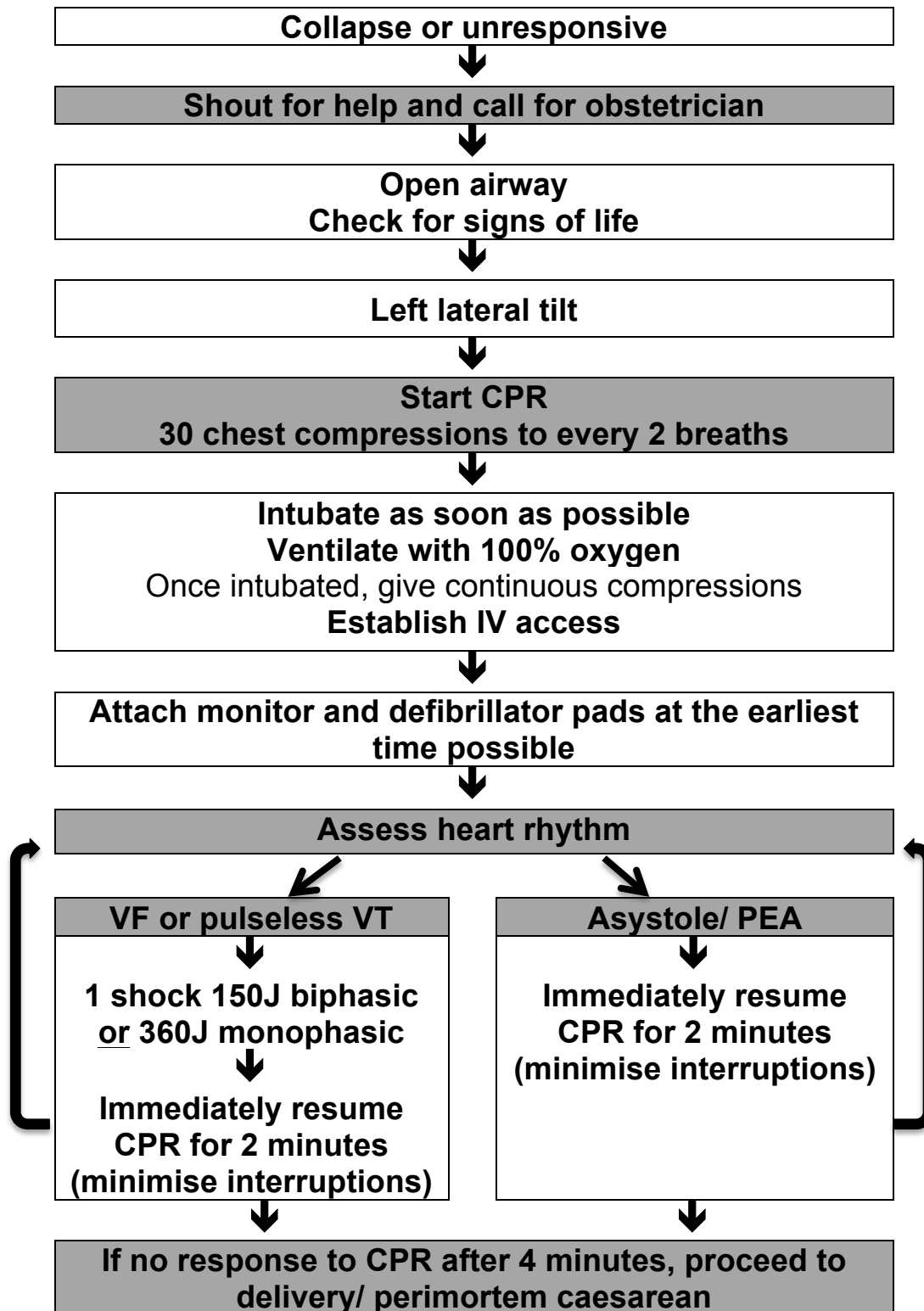
(Defibrillator *not* available)



Reversible causes for cardiac arrest 4 H's and 4 T's	
<ul style="list-style-type: none"> •Hypoxia •Hypovolaemia •Hypo- / Hyperkalaemia •Hypothermia 	<ul style="list-style-type: none"> •Toxins (Local anaesthetic) •Tension pneumothorax •Tamponade (cardiac) •Thromboembolism (pulmonary & amniotic fluid)
Don't forget ECLAMPSIA as possible cause in pregnancy	

Maternal Life Support

(Defibrillator available)

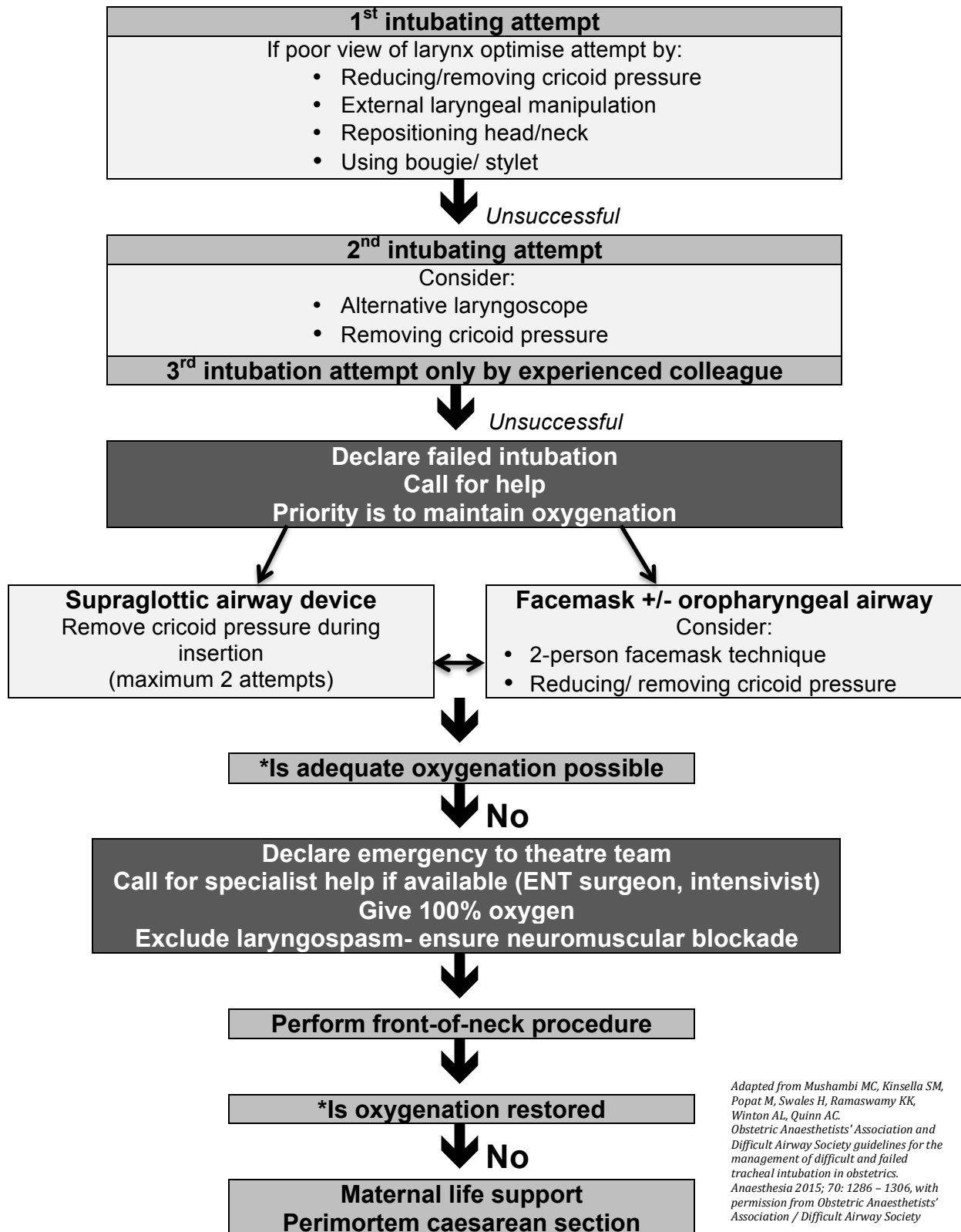


During CPR:

- Give 1mg adrenaline IV (10mls of 1:10,000) every 3-5 minutes
- Correct reversible causes (see page 50)

VF- Ventricular fibrillation; VT- Ventricular tachycardia; PEA- Pulseless electrical activity

Failed Intubation



Adapted from Mushambi MC, Kinsella SM, Popat M, Swales H, Ramaswamy KK, Winton AL, Quinn AC. Obstetric Anaesthetists' Association and Difficult Airway Society guidelines for the management of difficult and failed tracheal intubation in obstetrics. Anaesthesia 2015; 70: 1286 – 1306, with permission from Obstetric Anaesthetists' Association / Difficult Airway Society

*If oxygenation is adequate at this stage, consider if it is essential to proceed with surgery immediately.
If **Yes** → Maintain anaesthesia and consider merits of controlled versus spontaneous ventilation
If **No** → Wake the patient. Consider regional anaesthesia technique or awake intubation

High Spinal and Total Spinal

High spinal = Local anaesthetic block extending above T4 level

Total spinal = Intracranial spread of local anaesthetic leading to loss of consciousness

Prompt recognition and management will minimise harm to mother and baby (see important innervations on page 44)

Recognition	<ul style="list-style-type: none"> • Weakness or tingling of arms, neck or jaw • Nausea, vomiting and feeling faint • Marked hypotension or bradycardia • Difficulty breathing or coughing • Change in voice or hoarseness • Loss of consciousness
	Recognise symptoms and signs early as they can lead to respiratory and cardiac arrest
Management	Call for help and alert surgeon Assess patient using ABC approach Treatment is mainly supportive until spinal wears off
	A Give high flow oxygen and support airway May need intubation – remember cricoid pressure
	B Ventilate patient if poor respiratory effort
	C Confirm patient is in left lateral tilt Treat hypotension: <ul style="list-style-type: none"> • IV fluids and IV vasopressors (ephedrine, phenylephrine, metaraminol or adrenaline) Treat bradycardia: <ul style="list-style-type: none"> • IV atropine Start Cardio-Pulmonary Resuscitation if patient has a cardiac arrest Consider delivery of baby , whilst treating mother
	Ventilation is usually necessary for 1-2 hours until the spinal block has worn off – remember to provide low dose anaesthetic while intubated (e.g. halothane)

Major Obstetric Haemorrhage

Major Obstetric Haemorrhage = Blood loss > 1500ml

Recognition of blood loss and hypovolaemia:

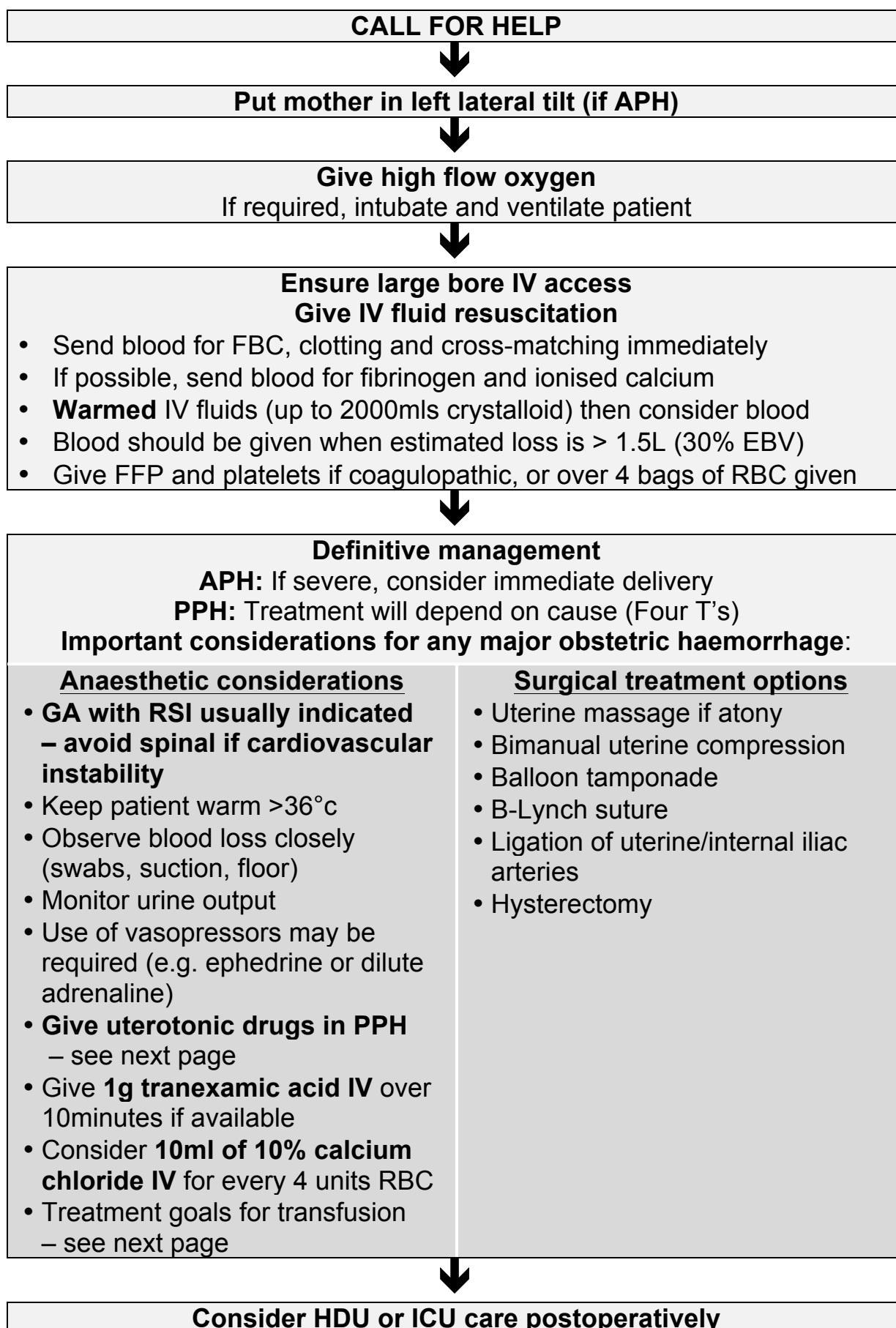
- **Blood loss is often underestimated**
- Better estimation will help identify high risk mothers and will guide fluid resuscitation
- Note that a fall in BP may only occur after 2 litres of blood loss
- **Remember:**
 - Blood soaked large swab (mop) = **300mls blood**
 - Blood soaked bed sheet = **1000mls blood**
 - Blood soaked bed sheet and pool on floor = **2000mls blood**

Circulating volume lost (% estimated blood volume)	Signs
Up to 500 ml (10%)	No symptoms or signs
1.5 litres (30%)	Increase in pulse and respiratory rate, cold, pale
2 litres (40%)	Increase in pulse and respiratory rate, fall in blood pressure , cold, clammy
Over 2 litres (>40%)	Rapid pulse and respiratory rate, low blood pressure , cold, clammy, confused

Causes of obstetric haemorrhage (the Four T's)

Cause	Description
Tone	Uterine atony (the most common cause)
Tissue	Retained products within the uterus or placental diseases (e.g. placenta accreta)
Trauma	Genital tract trauma, surgical bleeding
Thrombin	Poor clotting function

Management of major obstetric haemorrhage



Uterotonic Drugs for the management of PPH		
Drug	Dose	Comment
Oxytocin (Syntocinon)	5 iu IV bolus 40iu infusion over 4 hours	Can cause tachycardia, flushing and hypotension
Ergometrine	0.5 mg IM or slow IV injection	Extreme caution in PET or cardiac disease – can cause severe hypertension
Syntometrine	<i>As above</i>	<i>Combination of oxytocin and ergometrine</i>
Carboprost	0.25 mg IM every 15 minutes (max. 2mg)	Caution in asthmatics – can cause severe bronchospasm
Misoprostol	1 mg PR	Can only be given rectally

Treatment goals for transfusion in major obstetric haemorrhage
<ul style="list-style-type: none"> • Haematocrit >0.3 • Platelets >100x10⁹ /L • Fibrinogen >2g/ L • Ionised calcium >1 • Temperature >36°C

Pre-eclampsia and Eclampsia

Pre-eclamptic toxemia (PET)

- PET is a leading cause of maternal death
- It is characterised by hypertension and proteinuria
- It is a multi-systemic disorder occurring after 20 weeks of pregnancy
- Pathophysiological changes are described below

CVS	<ul style="list-style-type: none"> • Hypertension (BP >140/90mmHg) • Reduced intravascular volume but increased total body water • Increased sensitivity to vasopressors • Increased capillary permeability which leads to pulmonary and laryngeal oedema
Haematological	<ul style="list-style-type: none"> • Reduced platelet count and risk of disseminated intravascular coagulation
Renal	<ul style="list-style-type: none"> • Increased permeability giving proteinuria • Oliguria and renal failure in severe disease
Cerebral	<ul style="list-style-type: none"> • Headache, visual disturbance, hyperreflexia • Cerebrovascular haemorrhage • Eclampsia
Placenta	<ul style="list-style-type: none"> • Poor perfusion and reduced fetal growth

Key points in management of PET

- Eclampsia is an emergency that requires immediate treatment
- PET or eclampsia do not require immediate caesarean section
- **It is essential that seizures are treated and blood pressure is under control before proceeding to caesarean section**
- Treatment should aim to **reduce BP to <140/90mmHg**
- If caesarean section is required, either spinal or general anaesthetic technique can be used but special considerations should be taken (see next page)
- Careful fluid management is important (see next page)

Anaesthesia for caesarean sections with PET

- **Either spinal or general anaesthesia can be considered**
- **Spinal anaesthesia** may be safer if the patient is cooperative and is not coagulopathic (platelet count should be $>80 \times 10^9/L$ within last 4 hours before spinal)
- Fluid preloading for spinal anaesthesia is **not recommended**
- **GA may be required** if there is abnormal coagulation, severe haemorrhage, frequent seizures or need for immediate delivery
- Make sure a **smaller size ETT** is available (airway oedema)
- Aim to **reduce hypertensive response of intubation** by using IV labetalol, magnesium sulphate or fentanyl before induction
- Use **smaller doses of vasoconstrictors** (increased sensitivity)
- **Ergometrine should be avoided**
- **NSAIDs should be avoided** for post-operative analgesia
- Patient should be **managed in HDU** after delivery

Fluid management

- Fluid management can be difficult in pre-eclampsia
- Excessive fluid load may lead to pulmonary oedema but underfilling may affect renal function and fetal circulation
- Post partum fluid management needs careful attention – **fluid restrict to 1ml/kg/hr** of normal saline and reassess regularly
- Fluid balance chart recording all input and losses is essential

Drugs used to control hypertension in pre-eclampsia

Drug	Dose and Route	Comments
Methyldopa	PO: 250mg 8 - 12 hourly	Slow onset of action
Nifedipine	PO: 5mg, repeated once	Do not use sublingually
Labetalol	PO: 200mg 12 hourly IV: 5-10mg every 5 mins Maximum of 200mg	Not in severe asthma May cause neonatal hypoglycaemia
Hydralazine	IV: 5-10mg every 5 mins Maximum of 40mg	Can cause headache, flushing, vomiting
Magnesium Sulphate	IV: Loading 4g over 10 min IM: Loading 10g, then maintenance of 5g 4 hourly	See next page for further details

Management of Eclampsia

CALL for HELP: obstetrician, midwife and anaesthetist



Full left lateral position



ABC approach

- | | |
|----------|---|
| A | Give high flow oxygen and support airway (jaw thrust, chin lift) |
| B | If there is poor respiratory effort, assist with bag valve mask ventilation. Intubation may be required |
| C | Gain IV access |



Definitive treatment

Stopping seizure minimises cerebral hypoxia and oedema

Magnesium sulphate is the drug of choice

Loading dose:

- 4g magnesium sulphate IV (slow injection over 5-10 minutes)

Maintenance dose:

- IV infusion at rate of 1g/hr (if infusion pump available) **OR**
- 8g IM after loading dose, followed by 4g IM every 4 hours. Add 1ml 2% lidocaine with each IM to reduce pain of injection
- Continue treatment for 24 hours after delivery (or after last seizure)

Note: If magnesium is unavailable, 10mg diazepam IV can be used but respiratory rate must be monitored until patient fully awake.



Further management

- Control high BP to reduce risk of cerebral haemorrhage
- Plan for delivery of baby once mother is stable
- Cautious fluid management to minimise risk of pulmonary oedema

Magnesium toxicity

Withhold or delay a further dose of magnesium if:

- Respiratory rate <14 per minute
- Patella reflexes are absent
- Urine output <30ml/hr in the past 4 hours

In case of respiratory arrest: intubate, ventilate and give 1g of calcium gluconate IV (10ml of 10% calcium gluconate)

Drug Formulary

A reminder about drug concentrations:

Calculation of Drug Concentrations

Percentage solutions (e.g. local anaesthetics)

To convert a % solution to mg/ml, multiply by 10

For example:

1% solution = 10mg/ml

2% solution = 20mg/ml

0.5% solution = 5mg/ml

0.25% solution = 2.5mg/ml

Ratio solutions (e.g. adrenaline)

**1:1000 means there is 1g (1000mg) in 1000mls
or 1mg / ml**

For example:

1:1000 = 1mg/ml

1:10,000 = 0.1mg/ml = 100 mcg/ml

1:100,000 = 0.01mg/ml = 10 mcg/ml

Paediatric Drug Doses

Drug	Dose	Comments
Adrenaline (cardiac arrest)	10 mcg/kg IV (0.1mls/kg 1:10,000)	Give every 3-5 mins in cardiac arrest
Adrenaline (anaphylaxis)	150 mcg IM (0.15mls of 1:1000) 300 mcg IM (0.3mls of 1:1000) 500 mcg IM (0.5mls of 1:1000)	Child under 6 years Child 6 – 12 years Child over 12 years
Adrenaline (severe hypotension)	1 – 10 mcg/kg IV (0.01-0.1mls/kg 1:10,000)	Can cause arrhythmias with halothane
Amoxicillin	30 mg/kg IV Every 8 hours	<i>Max. 1g every 8hrs</i> Contains penicillin
Atracurium	0.5 mg/kg IV	Duration 20-30 mins
Atropine	10 – 20 mcg/kg IV 10 – 30 mcg/kg IM 40 mcg/kg PO	<i>Max. 1.2mg</i>
Benzylpenicillin	25 – 50 mcg/kg IV Every 6 hours	<i>Max. 2.4g every 6hrs</i> Contains penicillin
Bupivacaine	Max safe dose: 2 mg/kg	Duration 3 – 5 hours
Cefotaxime	25 – 50 mg/kg IV Every 8 hours	<i>Max. 12g daily</i> Caution in penicillin allergic patients
Ceftriaxone	50 mg/kg IV Every 24 hours	<i>Max. 4g daily</i> Caution in penicillin allergic patients
Cefuroxime	20 - 50 mg/kg IV Every 8 hours	<i>Max. 1.5g every 8hrs</i> Caution in penicillin allergic patients
Ciprofloxacin	10 mg/kg PO/IV Every 8 hours <i>Neonate: every 12hrs</i>	<i>Max. 400mg per dose</i>
Cisatracurium	150 mcg/kg IV	Duration 40-60 mins
Co-amoxiclav (Augmentin)	30 mg/kg IV Every 8 hours <i>Neonate every 12hrs</i>	<i>Max. 1.2g per dose</i> Contains penicillin
Codeine Phosphate	1 mg/kg PO Every 6 hours	<i>Max. 60mg per dose</i> Only use for children over 12 years; avoid in sleep apnoea
Cyclizine	0.5 – 1 mg/kg IV/IM Every 8 hours	<i>Max. per dose:</i> <i><12yrs: 25mg</i> <i>>12yrs: 50mg</i> Causes drowsiness

Dexamethasone	0.1 mg/kg IV	<i>Max. 20 mg daily</i>
Diamorphine	20-50 mcg/kg IV/SC Every 6 hours	<i>Max. 5mg every 6hrs</i> Strong opioid
Diazepam (in seizures)	0.2 – 0.3 mg/kg IV 0.5 mg/kg PR	<i>Max. 10mg every 10mins for seizures</i>
Diclofenac	0.5 mg/kg IV/IM 1 mg/kg PO/PR	<i>Max. 150mg daily</i> Avoid in children under 6 months
Epinephrine	<i>see Adrenaline</i>	<i>see Adrenaline</i>
Erythromycin	12.5mg/kg IV/PO Every 6 hours	<i>Max. 1g every 6hrs</i>
Etomidate	0.15 – 0.3 mg/kg IV	<i>Max. dose 60mg</i> Causes adrenal suppression
Fentanyl	1 – 2 mcg/kg IV	Strong opioid, potent respiratory depressant
Flucloxacillin	25 mg/kg IV Every 6 hours	<i>Max. 2g every 6hrs</i> Contains penicillin
Frusemide	0.5 – 1 mg/kg IV Every 12 hours	<i>Max. 40mg every 8hrs.</i> Potent diuretic
Gentamicin (surgical prophylaxis)	2mg/kg IV <u>SLOW</u> IV injection	<i>Max. 120mg</i>
Gentamicin (treatment of sepsis)	7 mg/kg IV Once daily <u>SLOW</u> IV injection	<i>Max. 500mg</i> Monitor gentamicin blood levels closely
Glucose (dextrose)	2 mls/kg of 10% glucose IV	Dilute 50% dextrose to make 10% dextr.
Glycopyrrolate	10 mcg/kg IV	<i>Max. 200mg per dose</i>
Hydrocortisone	2-4 mg/kg IV Every 6-8 hours	<i>Max. 100mg per dose</i>
Ibuprofen	5 mg/kg PO Every 6-8 hours	<i>Max 30 mg/kg daily</i> Caution in asthma and renal failure
Ketamine (induction)	1 – 2 mg/kg IV 5 – 10 mg/kg IM	Causes salivation, hallucinations
Ketamine (analgesic)	0.2 – 0.5 mg/kg IV 2 – 4 mg/kg IM	As above
Lignocaine (Lidocaine)	Max safe doses: 3 mg/kg (no adr.) 7 mg/kg (with adr.)	Duration 30-90 minutes, prolonged by adrenaline
Lorazepam	0.1 mg/kg IV	<i>Max. 4mg per dose</i>
Metaraminol	0.5 mg IV bolus,	Avoid in children under 12years
Metoclopramide	0.1 mg/kg PO/IM/IV Every 8 hours	<i>Max. 10mg every 8hrs</i>
Metronidazole	7.5 mg/kg IV/PO Every 8 hours	<i>Max. 500mg every 8hrs</i>
Midazolam	0.1 – 0.2 mg/kg IV 0.5 mg/kg PO/PR	Repeat dose once in 10 mins for seizure

Morphine	<u>Under 1 yr old:</u> 0.02 – 0.1 mg/kg IV <i>Max 0.4mg/kg 4hrly</i> 0.1 mg/kg PO Every 4-6 hours <u>1yr and older:</u> 0.05-0.1mg/kg IV <i>Max 5mg per dose, repeated to 20mg</i> 0.2-0.4mg/kg PO every 4 hours <i>Max dose 10mg</i>	See also page 13 Prolonged risk of respiratory depression, needs close observation: calculate exact doses for child's weight
Naloxone	5 – 10 mcg/kg IV	<i>Max. 2mg total</i>
Neostigmine	0.05 mg/kg IV	<i>Max. 2.5mg total</i> Add atropine or glycopyrrolate to avoid bradycardias
Ondansetron	0.15 mg/kg IV Every 8 hours	<i>Max. 4mg per dose</i> Only over 2 yrs old
Pancuronium	0.08 – 0.15 mg/kg IV	Duration 60 minutes
Paracetamol	15 mg/kg PO/IV Every 6 hours 20 mg/kg PR Every 8 hours	<i>Max. 60mg/kg daily</i>
Pethidine	0.5 – 1 mg/kg IV Every 4 hours	<i>Max. 400mg daily</i> Only over 1 year old
Phenobarbitone	20 mg/kg IV	<i>Max. 1g per dose</i>
Phenylephrine	5-20 mcg/kg IV bolus	<i>Max 500mcg every 15 minutes</i>
Phenytoin	20mg/kg IV loading	Slow IV infusion
Propofol	2 – 5 mg/kg IV (induction)	Caution in egg, nuts or soya allergies
Rocuronium	0.6 mg/kg IV	Duration 40 minutes
Salbutamol	Nebulised: 2.5mg (under 5 yrs) 2.5-5mg (over 5 yrs)	Causes tachycardia
Suxamethonium	2 mg/kg IV 4 mg/kg IM	<i>Max. 100mg IV</i> <i>Max. 150mg IM</i>
Thiopentone	2 – 4 mg/kg IV (induction)	
Tramadol	1 mg/kg PO/IV Every 6 hours	<i>Max. 100mg every 6hrs</i> Only over 1 year old
Vecuronium	0.1 mg/kg IV	Duration 30-40 mins
Vitamin K	1 mg IM	Recommended for all newborns

Obstetric Emergency Drug Doses

Drug	Dose	Comments
Adrenaline (cardiac arrest)	1 mg IV (10 mls of 1:10,000)	Give every 3-5 mins in cardiac arrest
Adrenaline (anaphylaxis)	500 mcg IM (0.5mls of 1:1000)	
Adrenaline (severe hypotension)	50 mcg IV boluses (0.5 ml of 1:10,000)	Can cause arrhythmias with halothane
Atropine	300 – 600 mcg IV	
Carboprost	250 mcg IM Every 15 mins	<i>Max. dose 2mg</i> Not to be given IV Caution in asthma
Diazepam (eclampsia)	10 mg IV 20 mg PR	Can be repeated once after 10 mins
Ephedrine	3 mg IV bolus	Reducing effect after multiple doses
Ergometrine	0.5 mg IV or IM <i>Slow IV injection</i>	Caution in PET and cardiac disease
Hydralazine	5 – 10 mg IV every 5 mins	<i>Max. dose 40mg</i>
Labetolol	200mg PO 12 hourly 5 – 10 mg IV every 5 mins (<i>max of 200mg</i>)	Caution in asthma Can cause neonatal hypoglycaemia
Magnesium Sulphate	4g IV loading dose	<i>For full dosing see page 59</i>
Metaraminol	0.5mg IV bolus	Reflex bradycardia
Methyldopa	250mg PO 12 hourly	Slow onset of action
Misoprostol	1 mg PR	
Nifedipine	5mg PO, repeat once	Not sublingual
Oxytocin (Syntocinon)	5 iu IV, then infusion of 40iu over 4 hours	Slow IV injection
Phenylephrine	50-100 mcg IV bolus	Reflex bradycardia
Tranexamic acid	1g IV over 10min	Repeat 1g over 1 hour if required

Tips on using your Lifebox pulse oximeter

- Monitor ALL your patients, even for minor procedures
- Keep the yellow cover on whenever possible to protect your Lifebox
- Only use soapy water to clean the probe
- If you are unsure about the readings, test the Lifebox on yourself
- You can plug the charging lead directly into the bottom of the Lifebox – you do not need to use the stand
- If the battery fails and there is no mains supply, you can use 3 x AA batteries in place of the rechargeable battery (remove battery cover). However, the AA batteries cannot be recharged so remember to keep the rechargeable battery safe
- For optimal battery life, when you first receive the oximeter, use it on battery power until empty and then charge fully again. If mains power supply is unreliable, remember to charge whenever possible to ensure you have as much battery charge as possible
- The Lifebox can be used on the mains supply, but remove the rechargeable battery if you use on mains supply all the time to avoid overcharging the battery; remember to keep the rechargeable battery safe if you remove it

*Are you having problems with your Lifebox?
Do you have any questions or need support?
Is your Lifebox broken?*

**WE CAN HELP - PLEASE E-MAIL US:
oximeters@lifebox.org**

Please include these details: your name, hospital, country, when you received the Lifebox and describe what the problem is.

We will e-mail you back.

www.lifebox.org

SBAR handover

Situation, Background, Assessment, Response

- SBAR is a structured way of **handing over a patient**, **requesting help** or **referring a patient** to another hospital
- It **improves communication** and **patient safety**

Situation	<ul style="list-style-type: none"> • Explain the current situation or your immediate concern about a patient • Include the patient's name, age and location <p>Example: I am in maternity theatre with 32 year old lady having a caesarean section for fetal distress. There is a large PPH and we are unable to control the bleeding</p>
Background	<ul style="list-style-type: none"> • Provide the important background history <p>Example: She is gravida 6, she is HIV positive but is on no medications normally</p>
Assessment	<ul style="list-style-type: none"> • Describe the vital signs and your assessment of the patient so far <p>Example: She is having a GA, her BP is 80/40 and pulse rate is 120bpm. She has lost 2L blood and her uterus is still atonic</p>
Response / Recommendation	<ul style="list-style-type: none"> • Make any of your own suggestions • Explain what response or help you would like, making it clear so this is understood <p>Example: We have given syntocinon, ergometrine and carboprost. She has had 2 units of blood. The intern who is operating would like senior assistance immediately</p>

10-step Anaesthetic Preparation Checklist

To be completed at the start of every list

1	Anaesthetic machine check
	<input type="checkbox"/> Perform your standard anaesthetic machine check <input type="checkbox"/> Make sure the vaporiser is filled
2	Oxygen supply and backup
	<input type="checkbox"/> Check primary oxygen supply <input type="checkbox"/> Check backup oxygen supply
3	Airway equipment
	<input type="checkbox"/> Ensure following items are ready , as a minimum: Facemask, Guedel, LMA, Laryngoscope, ETT, Bougie
4	Alternative ventilation
	<input type="checkbox"/> Ensure self-inflating bag is immediately available
5	Suction
	<input type="checkbox"/> Check suction is available and working
6	Monitoring
	<input type="checkbox"/> Check pulse oximeter and BP monitor are ready
7	Operating table
	<input type="checkbox"/> Ensure the operating table can be tilted
8	IV access and fluids
	<input type="checkbox"/> Ensure cannulae, fluids and IV giving lines are ready
9	Drugs, including emergency drugs
	<input type="checkbox"/> Prepare emergency drugs
10	Help
	<input type="checkbox"/> Where is your help and assistance if you need it?

Surgical Safety Checklist



World Health
Organization

Patient Safety
A World Alliance for Safer Health Care

Before induction of anaesthesia

(with at least nurse and anaesthetist)

Has the patient confirmed his/her identity, site, procedure, and consent?

☐ Yes

Is the site marked?

☐ Yes

☐ Not applicable

Is the anaesthesia machine and medication check complete?

☐ Yes

Is the pulse oximeter on the patient and functioning?

☐ Yes

Does the patient have a:

Known allergy?

☐ No

☐ Yes

Difficult airway or aspiration risk?

☐ No

☐ Yes, and equipment/assistance available

Risk of >500ml blood loss (7ml/kg in children)?

☐ No

☐ Yes, and two IVs/central access and fluids planned

Before skin incision

(with nurse, anaesthetist and surgeon)

☐ **Confirm all team members have introduced themselves by name and role.**

☐ **Confirm the patient's name, procedure, and where the incision will be made.**

Has antibiotic prophylaxis been given within the last 60 minutes?

☐ Yes

☐ Not applicable

Anticipated Critical Events

To Surgeon:

☐ What are the critical or non-routine steps?

☐ How long will the case take?

☐ What is the anticipated blood loss?

To Anaesthetist:

☐ Are there any patient-specific concerns?

To Nursing Team:

☐ Has sterility (including indicator results) been confirmed?

☐ Are there equipment issues or any concerns?

Is essential imaging displayed?

☐ Yes

☐ Not applicable

Before patient leaves operating room

(with nurse, anaesthetist and surgeon)

Nurse Verbally Confirms:

☐ The name of the procedure

☐ Completion of instrument, sponge and needle counts

☐ Specimen labelling (read specimen labels aloud, including patient name)

☐ Whether there are any equipment problems to be addressed

To Surgeon, Anaesthetist and Nurse:

☐ What are the key concerns for recovery and management of this patient?