



**EMERGENCY  
QUICK REFERENCE  
GUIDE**

# ESA/EBA TASK FORCE PATIENT SAFETY

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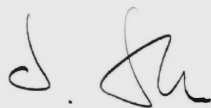
## Preface

The ESA and EBA Helsinki Declaration on Patient Safety in Anaesthesiology<sup>1</sup> requires to have protocols available for the management of perioperative complications. Based on the book "The Anaesthetic Crisis Manual"<sup>2</sup> by David Borshoff and the previous ESA project "OLEH" (Online Electronic Help) by Azriel Perel, the Task Force Patient Safety has developed checklists for various emergencies that appear similar to reference guides used in aviation for in-flight emergencies.

The first draft has been made available on the webpage of the European Society of Anaesthesiology at the end of the year 2012 for open feedback by every ESA member. Taking all the different and very valuable feedbacks into account, these emergency quick reference guidelines have been produced with prudence. Nevertheless, each practitioner is advised to pay careful attention when using these checklists as we do not take responsibility for the consequences out of their application. Furthermore we continue to invite everyone to give us qualified feedback for any possible improvement of these checklists in the future.

These checklists are thought to be a service for the ESA and EBA members and every anaesthetist or national anaesthesia society should feel free to adopt them to their local or national practice.

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**Sven Staender**  
(Chairman ESA/EBA Task Force Patient Safety)

- 1 Mellin-Olsen J, Staender S, Whitaker DK, Smith AF. The Helsinki Declaration on Patient Safety in Anaesthesiology. Eur J Anaesthesiol 2010 Jul;27(7):592-7.
- 2 Borshoff D. The Anaesthetic Crisis Manual. Cambridge University Press, Cambridge, UK 2011

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**Sign**

ECG: ST-Segment depression/elevation, new T-wave inversion, new dysrhythmias

**Goal**

Reduction in myocardial oxygen consumption and increase in myocardial oxygen delivery

**Oxygenation**

- Increase FiO<sub>2</sub> 100% (SpO<sub>2</sub> > 94%)
- Correct anaemia.  
Check Hb and consider transfusion (aim Hb 7 – 9 g/dl)

**Stress Response**

- Check depth of anaesthesia (avoid stimulation if possible)
- Sufficient analgesia

**Myocardial Perfusion Pressure**

- Increase perfusion pressure  
Consider Noradrenalin 5 – 10 mcg i.v. if HR > 90/min  
Consider Ephedrin 5 mg i.v. if HR < 90/min

**Heart Rate**

- Titrate to desired heart rate while avoiding hypotension
- Goal 60 – 80 beats/min  
Consider Esmolol 0.25 - 0.5 mg/kg i.v. ( $\pm$  50 – 200 mcg/kg/min)  
Consider Metoprolol 2.5 mg i.v.

**Contractility**

- Increase contractility  
Consider Dobutamin 2 – 4 mcg/kg/min

**Preload**

- Decrease preload  
Consider sublingual Nitroglycerine (NTG) initially or  
NTG infusion 0.5 - 1 mcg/kg/min  
Monitor carefully

**Volume status**

- Avoid hypovolaemia  
Consider volume load 20 ml/kg

**Consider further actions**

- Anticoagulation (Heparin and/or Aspirin)
- HDU/ICU admission  
Multi-lead ECG monitoring, invasive monitoring, TEE, 12-lead ECG asap, repeated lab check for troponin, CK, CK-Mb etc.
- Coronary intervention
- Intra-aortal balloon pump (IABP)

**Sign:**

- Hypotension
- Pulmonary edema
- Bronchospasm (increased insp. pressure, decreased compliance)
- Hypoxia
- Erythema / flush
- Angioedema
- Nausea / vomiting in awake patients

**Call for support / inform surgeon****Stop all potential triggering substances**

- e.g. drugs, colloids, blood products, latex products

**Full resuscitation (start chest compression if no carotid pulse for → 10 sec)**

- **Adrenaline** 1 mcg/kg i.v.  
Start adrenaline infusion 0.1 mcg/kg/min titrated to maintain systolic blood pressure at least 90 mmHg
- In Cardiovascular collapse:  
**Adrenaline 1 mg i.v. ADULT**  
**Adrenaline 10 mcg/kg i.v. CHILD**  
**Consider Vasopressin 2 U i.v. ADULT**

**Consider endotracheal intubation and FiO2 100%****Increase preload**

- Volume load (min. 20 ml/kg)
- Trendelenburg-Position (leg elevation, head down)

**Monitoring**

- Place arterial line  
**Take arterial blood gases**

**Consider further actions**

- Hydrocortisone bolus i.v. or i.m.
  - > 12 years: 200mg
  - 6-12 years: 100mg
  - < 6 years: 50 mg
- H-1-blocker:
  - **Clemastine** 2 mg bolus i.v. or i.m.
  - **Diphenhydramine** bolus i.v. or i.m.
    - <12 years: 1- 2 mg/kg max 50 mg
    - >12 years: 25 – 50 mg max 100mg
- H-2-blocker: **Famotidine** 20 mg i.v.
- Aminophylline bolus up to 5 mg/kg i.v. or i.m.
- Take blood samples for tryptase levels
  - when patient is stabilized
  - after 2 hrs and 24 hrs
- Arrange for allergy testing after one month

**Signs in the patient under anaesthesia:**

- Hypotension, tachycardia, circulatory instability
- Bronchospasm, wheezing, decreased pulmonary compliance,
- Hypoxia
- Urticaria, edema formation
- Bleeding from infusion sites and membranes
- Dark-coloured urine

**Call for support / inform surgeon****Stop transfusion, keep iv-line open (flush with saline)****Full resuscitation (airway, breathing, circulation)**

- Adrenaline 1 mcg/kg i.v.  
Start adrenaline infusion 0.1 mcg/kg/min titrated to maintain systolic blood pressure at least 90 mmHg
- In Cardiovascular collapse:  
Adrenaline 1 mg i.v. ADULT  
Adrenaline 10 mcg/kg i.v. CHILD

**Consider endotracheal intubation and FiO<sub>2</sub> 100%****Treat bronchospasm (see reference No.13)****Volume load (min. 20 ml/kg)****Trendelenburg-Position (leg elevation, head down)****Maintain urinary output**

- Use diuretics:  
Mannitol 25% 0.5 - 1 g/kg i.v.  
Furosemide 0.5 mg/kg i.v.

**Monitoring**

- Place arterial line  
Take arterial blood gases

**Further actions**

- Consider **Methylprednisolone** 1- 3 mg/kg i.v.
- Take care of developing coagulopathy:
  - coagulation lab
  - consult transfusion services/laboratory
- Collect and return all transfusion products
- Check ID of patient & blood documentation
- Take fresh urine and blood samples for analysis

**Signs in the patient under anaesthesia:**

- Desaturation
- Drop of  $\text{etCO}_2$
- Hypotension, tachycardia
- CV collaps
- Raised CVP or distended neck veins
- Bronchospasms, Pulm. edema
- Auscultation: 'Mill wheel' murmur

**Risk prone operations:**

- In general: surgical site higher than right atrium, e.g.: head down position and pelvic/lower abdomen surgery (Gyn., Urology)
- Laparoscopic surgery
- Surgery in sitting position

**Call for support / inform surgeon****Prevent further entrainment of air**

- Flood operative field with saline
- Compress bleeding sites

**Tilt table head down and left lateral**

- Caution: side supports on table?!
- In CPR: tilt table for operation side lower than level of heart (if possible)

**Switch to  $\text{FiO}_2$  100% (stop  $\text{N}_2\text{O}$ , if in use)****Relief pneumoperitoneum (if in use)****Cardiac support, avoid hypovolaemia**

- Maintain systemic arterial pressure with vasopressors/inotropic agents
- Increase venous pressure with fluids (20 ml/kg) and vasopressors
- Use RV failure algorithm (18b)

**Consider PEEP (controversial)****If central line in place: aspirate****Consider Closed Cardiac Massage**

- Comment: to break up large volumes of air
- Early TEE to rule out other treatable causes of pulmonary embolism

**Consider hyperbaric oxygen**

- Comment: Usefull up to 6 hrs after the event  
Especially in patent foramen ovale (up to 30% of general population)

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**Call for support / inform surgeon**

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**Ask for Suxamethonium to be prepared**

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**Ask for endotracheal tube to be prepared**

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**Children desaturate quickly**

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**100% Oxygen**

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**Cease all stimulation (surgeon, nurses, orderlies etc.)**

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**Remove any airway device and clear the airway**

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**Jaw thrust and gentle CPAP (20 – 30 cm H2O)**

- Guedel airway may be considered
- NO forced inflation attempts. May increase laryngospasm and may lead to aspiration

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**Consider deepening anaesthesia**

- In children extreme caution! Go directly to Suxamethonium

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**Suxamethonium if SpO2 still decreases**

- ADULT: Suxamethonium 1 mg/kg i.v.
- CHILD: Suxamethonium 1.5 mg/kg i.v.
- consider Atropine 0.02 mg/kg i.v. in advance to Suxamethonium

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**Intubate if necessary**

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**Consider Atropine when going into CV collapse**

- ADULT: Atropine 0.5 mg i.v.
- CHILD: Atropine 0.02 mg/kg i.v.

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**Stomach deflation after event**



## Clinical Signs:

- Hyperthermia
- Hypercapnia
- Increase etCO<sub>2</sub> without hypoventilation
- Tachycardia
- Sweating
- Masseter-Spasm
- Muscle rigidity

## Personal History:

In conjunction with congenital disease (Strabism, Muscle disease e.g. Duchenne)

- Trigger
- Volatile anaesthetics
- Suxamethonium
- Muscle relaxants

## Rapid Diagnosis

- Art. blood gases: combined respiratory & metabolic acidosis?
- Core temperature
- Temperature of absorber cannister (not specific)

## Differential Diagnosis

- Hypercapnia, tachycardia, sweating
  - **Rebreathing** (Deadspace spec. in children [long tube, extensions...])
  - **Exhausted Absorber**
  - **Low fresh gas flow**
- Metabolic acidosis
  - **Hypothermia, Shock, Sepsis, Hyperchloraemia**
- Hyperthermia
  - **Fever, external heating, Malignant Neuroleptic Syndrome, MAO-inhibitors, Atropine, Hyoscine, Cocain**
- Further differential diagnosis
  - **Hypoventilation, anaphylactic reaction, Pheochromocytoma, thyroid storm, cerebral ischaemia, neuromuscular disease, Capnoperitoneum, Ecstasy**

## If in doubt, treat

### Stop any trigger

- Switch off volatiles, switch to **Propofol**
- Exchange absorber
- Flush circuit with high flow oxygen

### Switch to 100% oxygen

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**Increase minute ventilation**

- Increase minute ventilation at least 3 times
- High fresh gas flow 100% O<sub>2</sub>

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**Dantrolene 2.5 – 8 (max. 10) mg/kg i.v.**

- Titrate according to heart rate, rigidity and patient temperature

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**Cooling**

- Stop cooling at < 38.5° C

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**Treat hyperkalaemia**

- 200 ml **Glucose** 20% with 20 U regular **Insulin** over 20 min i.v.
- 10 ml **Calcium chloride** 10% over 10 min i.v.
- **Calcium-Gluconat** (100 mg/kg i.v.)
- Inhalative Beta-2 Agonist (Salbutamol)
- Consider Dialysis

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**Treat acidosis**

- Hyperventilation
- **Sodium-Bicarbonate** (1 mEq/kg, max 50 – 100 mEq)

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**Monitoring**

- Core temperature, minimum 2 peripheral lines
- Consider arterial and central line, foley catheter
- Monitor liver- and renal function
- Beware of compartment syndrome

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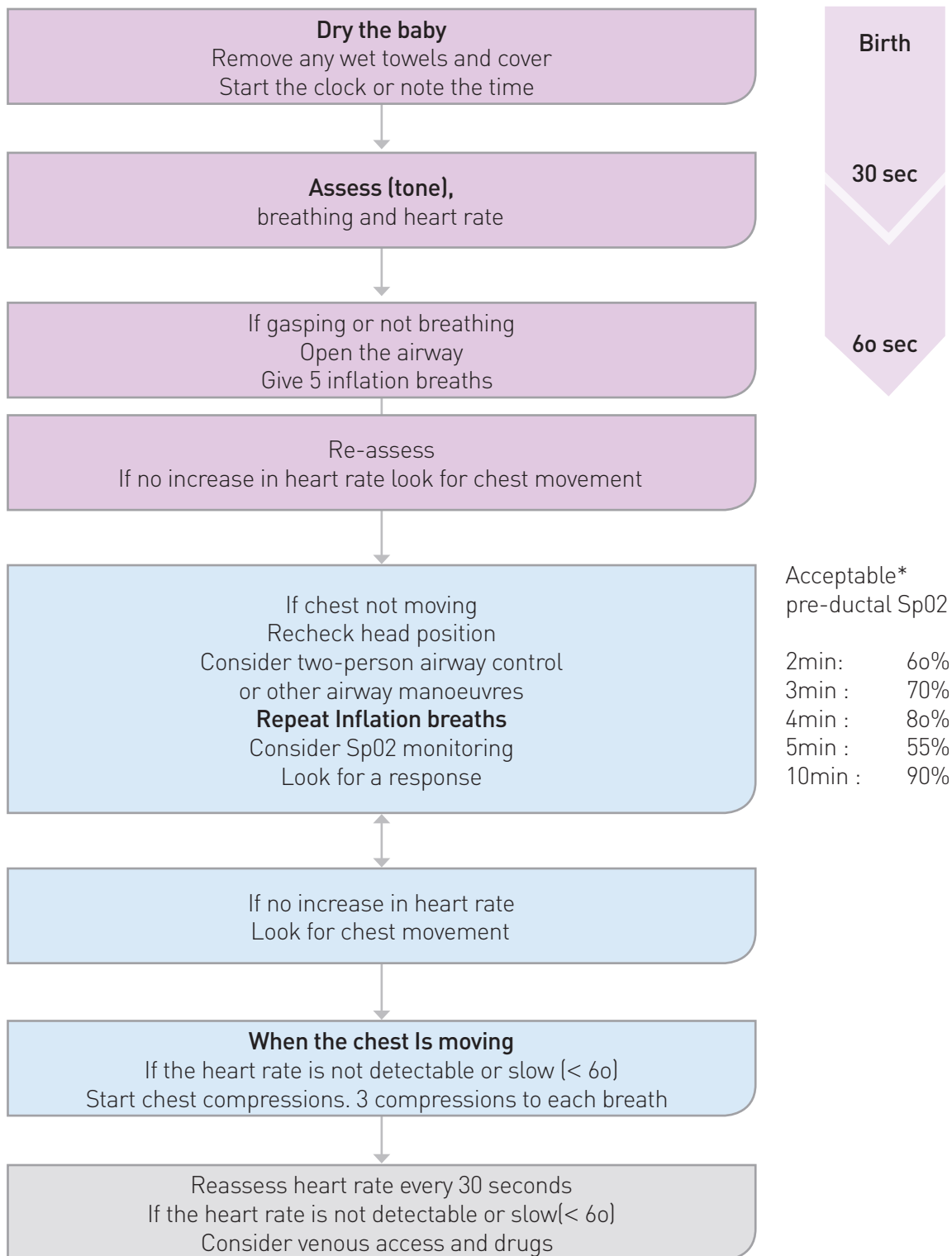
**Laboratory values**

- Arterial blood gases
- Na, K
- CK

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**Your national MH-hotline  
Tel.-number:**

## At all stages ask: Do you need help?



\* [www.pediatricresuscitation.org/cg/doi/10.1542/pedS.2009-t5t0](http://www.pediatricresuscitation.org/cg/doi/10.1542/pedS.2009-t5t0) Copyright European Resuscitation Council - [www.erc.edu](http://www.erc.edu) - 2013/005

**Mild Bronchospasm:**

- Check airway position
- Deepen anaesthesia
- Use inhalational bronchodilator therapy

**Commence manual ventilation, deepen anaesthesia****Check ...**

- Correct airway position
- Capnography
- Airway pressure

**Rule out ...**

- Severe allergic reaction
- Pneumothorax (previous central line placement ?)
- Left heart failure

**Switch to 100% oxygen****2 - 3 puffs Salbutamol**

- Use adaptor for circuit or ETT (endotracheal tube)
- Repeat if required
- Consider Salbutamol i.v. bolus (4 mcg/kg i.v. or s.c.), repeat if necessary

**Ventilator settings**

- Long expiration phase
- Intermittent disconnection to avoid overinflation of the lungs and allow for CO<sub>2</sub> escape
- Low grade PEEP

**Monitor treatment response**

- Capnography
- Airway pressure

**Consider further actions**

- **Adrenaline** bolus 0.1 - 1 mcg/kg i.v. (titrate)
- **Magnesium** 50 mg/kg over 20 min (max. 2 g) i.v.
- **Aminophylline** 5 - 7 mg/kg over 15 min i.v.
- **Hydrocortisone** 1 - 2 mg/kg i.v.
- **S-Ketamine** 0.5 - 1 mg/kg i.v.
- Expanded monitoring with arterial line and serial blood gases
- HDU / ICU admission

**Signs:**

- Seizures
- Slurred speech
- Numb tongue
- Tinnitus
- Metallic taste
- Higher degree AV-block during/after LA-Injection
- Hypotension
- Wide QRS complex
- Bradycardia deteriorating into PEA and asystole

**Stop LA-drug administration****Commence CPR if necessary**

- Small doses of epinephrine if LA toxicity is strongly suspected (10 – 100 mcg i.v.)
- Vasopressin is NOT recommended

**Treat convulsions (beware of cardiovascular instability)**

- Midazolam 0.05 - 0.1 mg/kg (70 kg: 5 - 10 mg)  
(20 kg: 1 - 2 mg)
- Thiopentone 1 mg/kg
- Propofol 0.5 - 2 mg/kg (70 kg: 50 - 100 mg)  
(20 kg: 20 - 40 mg)

**Intralipid 20%**

- 1.5 mg/kg bolus i.v. over 1 minute (100 ml in adults) repeat every 5 min up to a max of 3
- Followed by 15 ml/kg/h (1000 ml per h in adults)

**Treat cardiac arrhythmias**

- Avoid Lidocaine
- Caution with Betablockers (Myocardial depression)
- Consider Amiodarone
- Consider transcutaneous or intravenous pacemaker for symptomatic bradycardic rhythm with pulse

**Consider additionally**

- H1 blocker: **Diphenhydramin** 50 mg i.v.
- H2 blocker: **Famotidine** 20 mg i.v.
- **Sodium bicarbonate** to maintain pH > 7.25
- Continue CPR for a prolonged period (at least 60 min)
- ECMO

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### EKG-signs:

- Peaked T-Waves
- Loss of P-Waves
- Prolonged PR-Intervall
- Widened QRS-complex
- Loss of R-Amplitude
- Asystoly

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### Stop any further K<sup>+</sup> administration

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### Hyperventilation (K<sup>+</sup> shift)

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### Drugs

- Adult:
  - 10 ml **Calcium chloride** 10% over 10 min i.v.
  - **Sodium bicarbonate** 8.4% 50 ml i.v.
  - 200 ml **Glucose** 20% with 20 U regular Insulin over 20 min i.v.
- Child:
  - **Calcium chloride** 10% 0.2 ml/kg over 10 min i.v.
  - **Glucose** 20% 0.5 g/kg with regular **Insulin** 0.1 U/kg i.v.

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### Consider further actions

- Nebulized Salbutamol
- Diuretics (Furosemide)
- Potassium-exchange resins (sodium polystyrene sulfonate)
- Hemodialysis

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## **Airway manoeuvres**

- Suction oropharynx
- Tilt surgical table „head down“ position
- No cricoid pressure (Sellick) during active vomiting (risk of esophageal rupture)
- Perform laryngoscopy
- Suction pharynx
- Intubate and suction bronchial tree through endotracheal tube BEFORE first manual ventilation

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## **Adjust FiO2 and PEEP according to oxygenation**

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## **Suction stomach before emergence**

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## **Consider further actions**

- Consider bronchoscopy
- In severe aspiration, surgery should only be performed if really urgent
- Consider HDU/ICU admission
- If patient is asymptomatic 2 hrs after event with normal saturation and chest x-ray, ICU admission is not necessary
- NO lavage
- NO steroids
- NO antibiotics

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**Preparation / Monitoring**

- 2 large bore i.v. catheters
- Foley catheter (urine output)
- Temperature-probe
- **Warm Patient actively !**
- Consider arterial and central line (use ultrasound in impaired coagulation)
- Consider rapid-infusion device and cell-salvage system
- Consider anaesthesia induction with already running norepinephrine pump

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**Laboratory aspects**

- Contact and coordinate with blood bank early
- Cross match and antibody screen (Type & screen)
- Blood count (Haemoglobin, haematocrit, thrombocytes)
- Coagulation status (incl. Fibrinogen)
- Art. blood gases (pH, Hb, ionised Ca, Lactate)

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**Basic therapy**

- Keep normothermic (> 36 °C)
- Keep normocalcaemic (1.1 - 1.3 mmol/l, titrate Ca 1 - 2 g i.v.)
- Correct acidosis (keep normovolaemia)
- Keep haematocrit at 21% - 24%
- Aim for MAP 55 - 65 mmHg (severe head trauma MAP 80 - 90 mmHg)

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**Advanced therapy**

- **Fibrinogen** 2 g up to max. 6 g Aim for: Fbg > 2 g/l
- **FFP** init. 15 - 20 ml/kg (~ 2 - 4 bags) Aim for: INR < 1.5
- **Tranexamic acid** 15 mg/kg bolus slowly i.v.  
(especially in local hyperfibrinolysis, e.g. uterine atony or abortion!)
- **Thrombocytes:** aim for > 50'000/ul  
(Tc > 100'000/ul in severe head trauma)



**1. DISTINGUISH****Circuit**

- Respirator settings
- Kinked tubing
- Valve failure
- Failure of high pressure valve
- Failure of O<sub>2</sub>-flush

**Airway**

- Laryngospasm (if not intubated)
- Tube position
- Tube size
- Blocked or kinked tube (patient biting on tube)

**Patient**

- Bronchospasm
- Laryngospasm (if not intubated)
- Pneumothorax
- Pneumoperitoneum
- Tracheal pathology
  - Foreign body (e.g. chewing gum)
  - Secretions
  - Tumor
- Chest wall rigidity
- Obesity
- Alveolar pathology
  - Oedema
  - Infection
  - ARDS
  - Contusion
  - Fibrosis

**Most likely**

- Insufficient relaxation
- endotracheal tube position
- Laryngospasm (if not intubated)
- Respirator settings

**2. ACTIONS****Check**

- Muscle relaxation
- Depth of anaesthesia
- Capnogram
  - Bronchospasm ?
  - Kinked endotracheal tube ?
- Spirometry
  - Endobronchial intubation ?
  - Kinked endotracheal tube ?
- Tubing circuit
  - Kinked tubing ?
  - Obstructed tubing ?

**Do**

- Auscultate
- Manually ventilate
- Suction bronchial tree
- Flexible bronchoscopic exam
- If LMA in place consider endotracheal tube

**If problems persist**

- Review possible patient causes
- Call for assistance
- Repeat checklist together

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**No etCO<sub>2</sub>**

- No etCO<sub>2</sub> - NO VENTILATION, NO PATENT AIRWAY !!!
- Oesophageal intubation?
- Disconnection of tubing, complete failure of respirator
- Apnea
- Cardiac arrest

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**Diminished production of CO<sub>2</sub>**

- Hypothermia
- Deep anaesthesia
- Hypothyroidism

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**Enhanced excretion of CO<sub>2</sub>**

- (Spontaneous) hyperventilation
- Inappropriate ventilator setting

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**Reduced transport of CO<sub>2</sub> in blood**

- Severe hypotension
- Anaphylaxis
- Cardiac arrest
- Pulmonary embolus

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**Reduced transport of CO<sub>2</sub> in lung**

- Endotracheal tube obstruction
- Incorrect airway placement (endobronchial intubation)
- Laryngospasm
- Severe bronchospasm

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**Sampling dilution**

- Disconnection of respirator
- Dilution of sampling gas with room-air
- Gas sampler placed wrong
- High fresh gas flow in circuit

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**Most likely**

- Rule out **MALPLACED AIRWAY** (OESOPHAGEAL)
- Hyperventilation (too high minute ventilation)
- Bronchospasm
- Laryngospasm
- Hypotension

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**Increased production of CO<sub>2</sub>****a. Exogenous:**

- CO<sub>2</sub> insufflation (e.g. laparoscopy)
- Bicarbonate administration
- Re-breathing (valves, Soda lime, fresh gas-flow)

**b. Endogenous:**

- Painful stimulus
  - Increased body temperature
  - Reperfusion after Tourniquet
  - Sepsis, Malignant Hyperthermia
  - Thyroid storm, Malignant Neuroleptic Syndrome
- 

**Reduced excretion of CO<sub>2</sub>****a. Lungs:**

- Hypoventilation (spont. or respirator settings)
- Bronchospasm, asthma
- COPD (chronic airway disease)

**b. Breathing circuit:**

- Increased dead space
  - Inadequate fresh gas flow
  - Valve malfunction
  - Incorrect respirator settings
- 

**Most likely**

- Hypoventilation (spontaneous or respirator settings)
- Exhausted soda lime
- Fresh gas flow setting

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**Primary causes**

- Atrioventricular block
- Pacemaker malfunction
- Cardiomyopathy
- Sick sinus syndrome
- Myocarditis
- Pericarditis
- Valvular heart disease
- Pulmonary Hypertension

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**Secondary causes**

- Electrolyte abnormalities
- Antiarrhythmic medication
- Hypothyroidism
- Hypothermia
- Hypervagal
- Increased intracranial pressure
- Tamponade
- Tension pneumothorax

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**Anaesthetic causes**

- Hypoxia
- Volatile agent side effects
- Muscle relaxant side effects
- Narcotic
- Anticholinesterase drugs
- High spinal/ epidural anaesthesia
- Local anaesthetic toxicity
- Hyper- Hypokalaemia
- Vasopressor reflex
- Auto-PEEP
- Malignant Hyperthermia

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**Most likely**

- Drug related
- Hypervagal
- Spinal anaesthesia
- Fitness

## Check / rule out

- Pulseoxymetry, Oxymeter, Skin and field blood colour: rule out hypoxia
- Hypovolaemia
- Auto-PEEP
- Gas/air embolism? Thrombo/fat embolism?
- High spinal/epidural
- Tension pneumothorax
- Tamponade
- Other primary, secondary or anaesthetic causes (see Reference Guide 16)

## In severe hypotension, poor perfusion, or low etCO<sub>2</sub>

- Start CPR
- Improve oxygenation
- Assist ventilation (avoid hyperventilation)
- Volume load (20 ml/kg), repeat if necessary
- Treat potential underlying cause (see check / rule out list above)
- Consider Atropine 0.5 mg i.v. (may repeat up to 3 mg in total)
- Consider Epinephrine 10 to 100 mcg i.v. (may repeat while awaiting pacer)
  - Consider Epinephrine infusion (0.05 – 0.1 mcg/kg/min)
  - Consider Dopamine infusion (2 – 10 mcg/kg/min)
- Consider Isoproterenol 4 mcg i.v. (may repeat while awaiting pacer)
- Consider arterial- and central venous line

## If the above is ineffective (use without delay in high-degree block)

- Transcutaneous pacing
- Esophageal pacing
- Transvenous pacing

## Consider expert consultation

Acc: Moitra V.K. et al: Can J Anesth/J Can Anesth (2012) 59:586–603

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**Primary causes**

- Cardiomyopathy
- Sick sinus syndrome
- Accessory conduction pathways (Re-entry)
- Myocarditis
- Pericarditis
- Valvular disease
- Congenital heart disease

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**Secondary causes**

- Hypovolaemia
- Anaesthetic depth
- Drugs
- Anxiety
- Pain
- Electrolyte abnormalities
- Cardiac tamponade
- Sepsis
- Thyreotoxicosis
- Lung disease
- Malignant hyperthermia

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**Most likely**

- Anaesthetic depth and surgical stimulation
- Anxiety and pain
- Hypovolaemia

## Check / rule out

- Light anaesthesia
- Hypovolaemia
- Auto-PEEP
- Early hypoxia or hypercapnea
- Other primary or secondary causes (see Reference Guide 17)

## In severe hypotension or poor perfusion

- Consider synchronized cardioversion

## Narrow QRS

- Rhythm **regular**
  - Consider vagal maneuvers
  - Consider **Adenosine** 6 mg i.v. push  
if no response give **Adenosine** 12 mg i.v. push
  - If still no conversion:  
consider beta blocker (e.g. **Metoprolol** 2.5 mg i.v.) or Ca channel blocker
- Rhythm **irregular**
  - Low ejection fraction (EF) or severe hypotension  
consider synchronized cardioversion  
consider load **Amiodarone** 150 mg i.v. over 10 min
  - Normal EF or acceptable blood pressure  
consider beta blocker (e.g. **Metoprolol** 2.5 mg i.v.) or Ca channel blocker

## Wide QRS

- Rhythm **regular**
  - If ventricular tachycardia or uncertain rhythm  
consider load **Amiodarone** 150 mg i.v. over 10 min and **Calcium chloride** 1 g i.v.  
if no Amiodarone available: **Lidocaine** 1 – 1.5 mg/kg i.v
- Rhythm **irregular**
  - If Torsade-de-Pointes  
Consider Magnesium Sulfate 2 g i.v. over 5 min (consider repeat)
  - If pre-excited atrial fibrillation  
consider load **Amiodarone** 150 mg i.v. over 10 min

## Consider expert consultation

Acc: Moitra V.K. et al: Can J Anesth/J Can Anesth (2012) 59:586–603

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**Preload Reduction**

- Blood loss
- Hypovolaemia
- Decreased venous return (caval vein?)
- Elevated intrathoracic pressure
- Cardiac Tamponade
- Embolism

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**Reduced Contractility**

- Drugs (including volatile agents)
- Ischaemic heart disease
- Cardiomyopathy
- Myocarditis
- Arrhythmia
- Valvular heart disease

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**Reduced Systemic Vascular Resistance**

- Volatile anaesthetics
- Narcotics
- Vasodilators
- Antihypertensive drugs
- Regional blockade (spinal/epidural)
- Sepsis
- Release of tourniquet
- Anaphylaxis
- Addison's disease
- Thyroid disease

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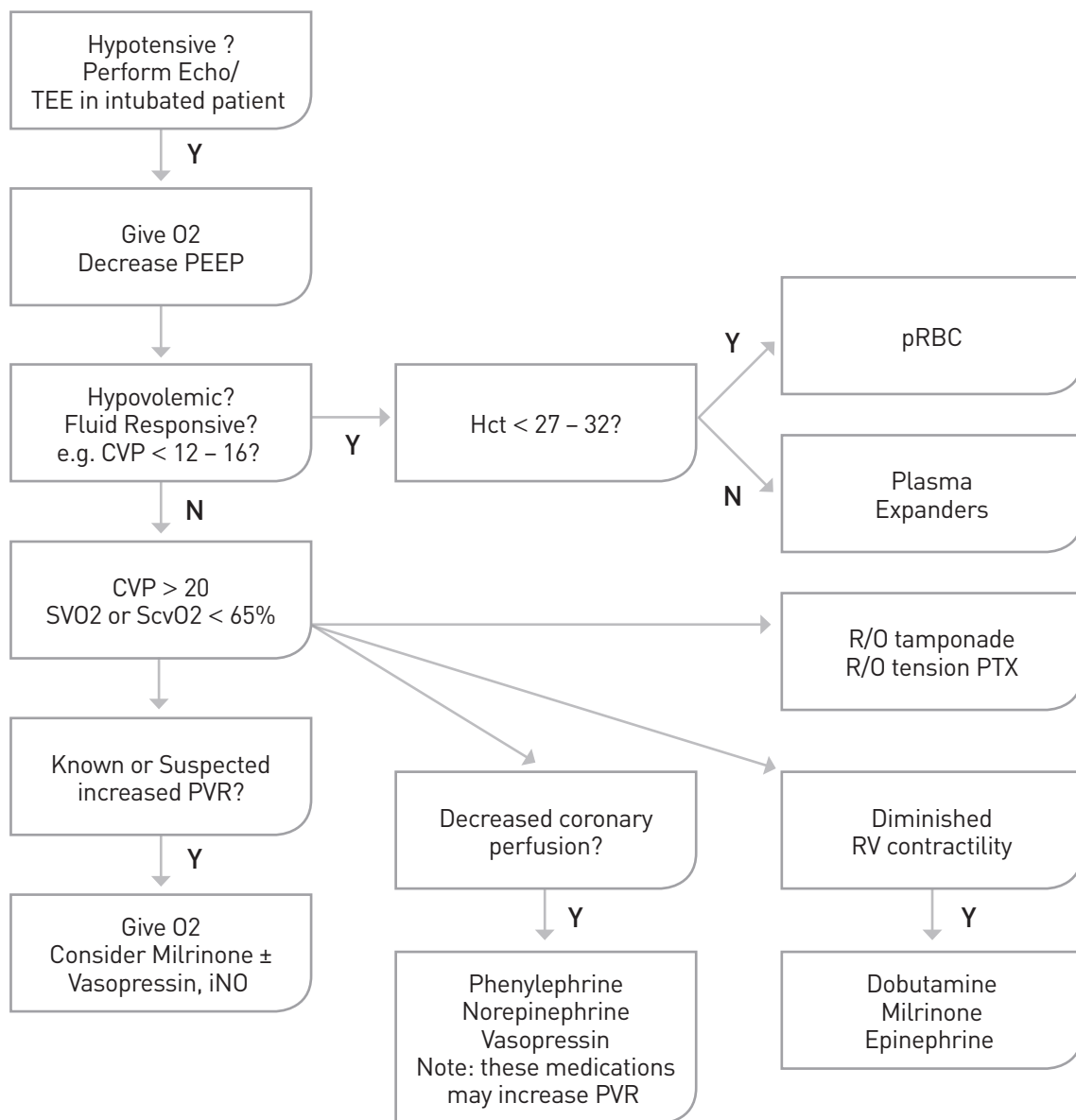
**Most likely**

- Depth of anaesthesia and volatile anaesthetics
- Narcotics
- Regional blockade (spinal/epidural)
- Hypovolaemia
- Transducer height (invasive monitoring)





# 18B RIGHT VENTRICULAR SHOCK



TEE = Trans esophageal echo  
 CVP = central venous pressure  
 pRBC = packed red blood cells  
 SVO2 = systemic oxygen consumption  
 ScvO2 = central venous oxygen saturation  
 PEEP = positive end-expiratory pressure  
 iNO = inhaled Nitric oxide  
 PVR: pulmonary vascular resistance

Moitra V.K. et al: Can J Anesth/J Can Anesth (2012) 59:586-603  
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