Shock

Contents

Introduction

The aim of this unit is to consider the physiology of body fluids and what happened when fluid depletion leads to shock. We will also look at the principal types of shock, their causes, signs and symptoms, and their management aspects.

We will also discuss pain management as this is an essential part of the management of shock along with O2 therapy.

The emphasis throughout this unit is to refresh your knowledge base. We will first of all look at background theory following with consideration for practical management.

Preparation

No specialist knowledge is required for this unit and no prior reading is expected. If you wish to read further details on physiology, please refer to a standard textbook.

Describe in your own words what you think shock is?

1. What is Shock?

"A rude unhinging of the machinery of life" (Gross 1850)

"Inadequate capillary perfusion" (Mosby's)

"A stage everyone must go through before they die" (Hardaway)

"A widespread lack of tissue perfusion with oxygenated red blood cells that leads to anaerobic metabolism and decreased energy production" Mosby's Pre-hospital Trauma Life Support (5th Ed. 2003)

Cellular metabolism depends on the supply of oxygen via the circulatory system – a process known as tissue perfusion. Shock therefore could be defined as the state when tissue perfusion is inadequate to sustain cellular metabolism.

The state may initially be reversible via:

- The body's physiological adaptive mechanisms and/or
- Medical resuscitative measures

But if these are ineffective, an irreversible phase develops, leading to death. Irreversibility occurs when either the depth or duration of inadequate tissue perfusion results in:

- Depression of the cardio-respiratory control centres in the brain
- Depression of myocardial contractility

Once this damage has occurred, even the most sophisticated resuscitative measures cannot prevent death. In order to prevent irreversible shock we need to do the following -

Maintain an effective circulation to the vital areas - the brain and the heart. In order to do this, we need to consider the 3 factors of:

- Pump (heart)
- Piping (blood vessels)
- Fluid (blood)

This alone will not be enough. What do we also need to ensure, as well as circulation? Take a moment to consider your answer, before reading on. We must also consider the maintenance of oxygenation. We will see later how this can be achieved. For now though we will consider:

- The physiology of body fluids
- The choice of replacement fluids in shock

2.Types of Shock

Reminder of a definition of shock

“Where tissue perfusion is inadequate to sustain cellular metabolism" and the fact that an effective circulation requires 3 intact systems.

- Adequate fluid - blood
- A normal pump – heart
- An intact piping system – vascular system

With this in mind we will be able to now look at how the five described types of shock closely relate to a failure of one or more of these systems.

Question A: Try to complete the table below using the 5 types of shock.

System	Problem	Type of Shock
Pump	Myocardial infarction	
Piping	Syncope, spinal cord injury (disruption of sympathetic chain)	
Fluid	Haemorrhage	Hypovolaemic
Mixed (fluid and piping)	Sepsis	
Mixed (fluid and piping)	Severe allergic reaction	

Pathogenesis of Shock

Shock may progress through an early reversible stage, during which the body tries to compensate through various physiological adaptation to an irreversible stage, with death being the end point if the compensatory changes, or the resuscitative measures, prove ineffective.

We will now use Hypovolaemic shock as an example and consider the cascade of events which leads to irreversible shock.

The reduction of blood volume leads to an initial fall in systolic pressure which activates an increase in sympathetic activity:

- Tachycardia
- Peripheral vasoconstriction
- Restoration of systolic blood pressure (though pulse pressure may be reduced with an increase of diastolic levels)

Blood flow is diverted to the vital areas of the brain, heart and kidneys at a cost of a reduction in peripheral perfusion. If this loss is allowed to continue then the reduced tissue perfusion leads to anaerobic metabolism and the development of metabolic acidosis (to which the body responds by over breathing, tachypnoea, and hypoxia). The combination of

metabolic poisoning and hypoxia leads to a depression of myocardial contractility, further reducing the circulation with a vicious downward spiral to death, due to multi organ failure.

Anaerobic metabolism is the creation of energy through the combustion of carbohydrates in the absence of oxygen. This occurs when the lungs cannot put enough oxygen into the bloodstream to keep up with the demands from the muscle's energy. It generally is used only for short bursts of activity.

Metabolic acidosis is a condition that occurs when the body produces too much acid or when the kidneys are not removing enough acid from the body. If unchecked, metabolic acidosis leads to acidemia, i.e., blood pH is low (less than 7.35) due to increased production of hydrogen by the body or the inability of the body to form bicarbonate (HCO3-) in the kidney. Its causes are diverse, and its consequences can be serious, including coma and death. Together with respiratory acidosis, it is one of the two general causes of acidemia.

Signs & Symptoms of Shock

The following signs and symptoms may be observed in shock:

- Hypotension (due to Hypovalaemic, later by myocardial depression as well)
- Skin pallor
- Tachycardia
- Mental changes of confusion, later drowsiness and finally coma (secondary to cerebral hypoxia and acidosis) leading on to death
- Tachypnoea (in response to hypoxia and acidosis)
- Thirst (due to hypovolaemia; urine output will reduce with a decline in renal perfusion)

Signs & Symptoms of Hypovolaemic Shock

Blood loss / ml	Stage 1 / <750ml 15% blood volume loss	Stage 2 / 750ml – 1500ml 15%-30% blood volume loss	Stage 3 / 1500ml – 2000ml 30%-40% blood volume loss	Stage 4 / >2000ml > 40% blood volume loss
Blood pressure	Normal	Normal or reduced pulse pressure	Reduced	Low or unrecordable
Pulse rate	Normal or slight increase	100 – 120 compensatory tachycardia	120 – 140 tachycardia	>140 thready
Resp. rate	Normal	Tachypnoea of 20-30	Tachypnoea of 30-40	35+
Capillary refill	Normal	>2 seconds	>2 seconds	No detectable refill
Skin pallor	Normal	Pale	Pale and clammy	Pale and cold
Conscious level	Alert	Possible anxiety	Anxious / confused	Likely to be confused, lethargic or unconscious

Cardiogenic Shock

Description

In this type of shock it is the pump that has failed. There is no fluid depletion as such, but the pump mechanism is unable to maintain an effective circulation.

Causes

Usually due to myocardial infarction where either:

- The size of the infarct prevents effective pumping.
- Or associated damage to the conduction pathways disturbs the rhythm (cardiac arrhythmia).
- A pulmonary embolus, where the blockage to the outflow of the right ventricle prevents an effective circulation
- A cardiac contusion secondary to thoracic trauma

Signs & Symptoms

These are inclusive of all that we mentioned earlier plus those specific to the cause, see below:

- Severe central chest pain
- Pulse irregularity

Management

- Establish and maintain a patent airway
- Beware of vomiting (common side effect of pain)
- Assist breathing if required
- Administer high dose of oxygen (15 litres per minute – 100%) depending on equipment and supply
- Stabilise rhythm if possible
- Use AED defibrillator for VF (ventricular fibrillation) We will run through this in greater detail and in practical sessions when you attend DDRC
- Control pain. Effective rapid pain relief reduces sympathetic activity and might reduce cardiac arrhythmia, improving cardiac output (pain relief is a primary treatment for the treatment and preventing of shock)
- Ensure you gain intravenous access via a cannula, FAST IO, or bone gun. Infuse patient with a crystalloid to maintain venous access, aim to give less than 1 litre over an 8 hr period.
- Keep patient warm and comfortable, head up preferably sitting.
- Monitor vital signs
- Discuss with Topside Doctor to arrange medical evacuation

Note: don't use dextrose if you are intending to administer Tenecteplase and only do this after you have got your patients written and verbal consent and also had an in depth discussion with your Topside Doctor.

Neurogenic Shock

Description

Neurogenic shock is a distributive type of shock resulting in hypotension, occasionally with Bradycardia, that is attributed to the disruption of the autonomic pathways within the spinal cord. Hypotension occurs due to decreased systemic vascular resistance resulting in pooling of blood within the extremities lacking sympathetic tone. Bradycardia results from unopposed vagal activity and has been found to be exacerbated by hypoxia and endobronchial suction. Neurogenic shock can be a potentially devastating complication, leading to organ dysfunction and death if not promptly recognised and treated. It is not to be confused with spinal shock, which is not circulatory in nature.

Causes

Neurogenic shock can result from severe central nervous system damage (brain injury, cervical or high thoracic spinal cord). In more simple terms: the trauma causes a sudden loss of background sympathetic stimulation to the blood vessels. This causes them to relax (vasodilation) resulting in a sudden decrease in blood pressure (secondary to a decrease in peripheral vascular resistance).

This interruption to the sympathetic nervous system may be:

- Direct - For example as a result of a head injury, or spinal injury to the sympathetic pathways descending in the cervical and upper thoracic spine.

- Reflex - As in a sycopal or (faint) attack, where sudden fright or pain triggers off excessive vasovagal activity.

Signs & Symptoms
There is hypotension without the sympathetic system effects of tachycardia or vasoconstriction.

Management
Management depends on the causes already discussed.

Head or Spinal Injury
Remember where a head or spinal cord injury is the causative factor; you must deal with this first. You should:

- Immobilise the spine
- Maintain an adequate airway
- Assist breathing if required
- Administer oxygen

Hypotension may be relieved by elevating the lower limbs. Do not attempt to correct the hypotension by vigorous infusion of intravenous fluid as this may lead to cerebral oedema and further deterioration in the casualty's condition.

Faint
Neurogenic shock induced by a faint, the commonest type, is only a transient phenomenon and can be managed simply and effectively by keeping the patient supine and elevating the legs.

Discuss further management with your Topside Doctor

Hypovolaemic Shock

Description

In hypovolaemic shock, whatever the cause, there is a reduction in the circulating blood volume.

Causes

Commonest cause you may encounter offshore is due to blood loss associated with trauma, other causes include:

- Burns. This leads to loss of plasma and interstitial fluid from the burn area
- Dehydration. Major fluid losses associated with vomiting, diarrhoea, heat induced illness, or metabolic disorders such as diabetes.

Signs & Symptoms

See table on page 5.

Remember we can't rely on blood pressure alone to diagnose shock. We will explain this statement now in simple terms.

In previously healthy adults, the systolic may be maintained by the compensatory mechanisms – despite blood losses of up to 32 litres. If these fail, there may be a sudden fall in blood pressure associated with a rapid deterioration in the clinical condition of the patient.

In a young person or previously fit casualty these may not show until these is >15% loss of blood volume, they are:

- Pallor
- Sweating
- Tachycardia >100per minute
- Delayed capillary refill>2 seconds
- Confusion
- Anxiety
- BP could be normal

The ideal fluid replacement regime would replace the fluid lost with:

- The same type of fluid
- The same volume of fluid lost

Management

As (haemorrhagic shock) "that is hypovolaemic shock secondary to haemorrhage" is probably the commonest type of Hypovolaemic shock you will encounter offshore, this guideline deals specifically with this situation. Brief details of other types will be outlined.

- Establish and maintain an airway

- Assist breathing if required
- Administer high concentration oxygen
- Control major external haemorrhage (this will be described later)
- Restore circulating fluid volume
- Monitor vital signs
- Control pain
- Discuss with Topside Doctor – probable medivac

Control of major external haemorrhage

Remember as well as looking to replace lost fluid you must endeavour to stop the loss of fluid. To do this you must have rapid effective control for major extensive haemorrhage if it is present, you should attempt the following:

Direct pressure

The most useful and effective measure to control the stem of bleeding is direct sustained pressure to the bleeding site. If a limb is affected then elevation while applying pressure will improve the effect.

In an emergency situation any absorbent dressing material can be used. Saturated dressing should not be removed and direct pressure should be maintained for a minimum of ten minutes or more until the bleeding ceases. The dressing should then be secured by firm bandaging.

Indirect pressure

This may be useful as an adjunct to direct pressure. Two useful pressure points are:

- The femoral artery in the groin
- The brachial artery (inner aspect of middle one third of upper arm)

Artery forceps

If the severed end of a major blood vessel can be seen, the application of artery forceps to clamp this shut could be seen as an alternative to direct pressure, this is however a method rarely used outside the operating theatre environment.

Tourniquet

A tourniquet should be used where there is uncontrollable (catastrophic bleeding) from a limb, or after traumatic amputation. This will be dealt with in more detail during your practical week at DDRC. Preferred type of tourniquet is the CAT 1 see diagram below:

Celox and other haemostatic agents

There may also be topical agents that you might have on board depending on your company's protocols, these come in various shapes and sizes and will be discussed and presented during your practical week. Most of these agents are or have been developed by the armed forces and are in use today around the world.

Celox is widely used in the UK and is easy to use. Available in granule, Z-fold bandage and applicator for a range of scenarios.

Restoration of circulating fluid volume

Once you have arrested the haemorrhage where the loss has been or below 500 ml, it is essential to replace the fluid volume. Fluid replacement can be via intravenous or intra osseous route.

You must make every effort to gain IV access using at least a 14g as soon as possible before your patient goes into peripheral shutdown, try to gain access at two points if time allows.

The ideal fluid replacement regime would replace the fluid lost with:

- The same type of fluid
- The same volume of fluid lost

For the Offshore medic the above is impossible to achieve as you won't have access to blood products and whilst there is worldwide research into finding an "oxygen carrying fluid" for the first aid environment, this has not been universally successful to date.

The second problem you have of replacing the exact volume of fluid lost is also more of an art than science as you can only make a best estimate of the volume required by combining estimates of two factors.

- Observed loss, or spilt blood, this is well known to be inaccurate as you will already be aware.
- The predicted loss associated with known injuries, there are figures that exist which give estimates of probable blood loss associated with certain types of fractures, see below:

It is worth noting that where the fracture is open, the loss may be 2-3 times the volume shown in the table.

Open fracture location	Blood loss in litres
Pelvis	4.0
Femur	2.5
Tibia	1.5
Humerus	1.5

It is also generally accepted that soft tissue injuries the size of your fist equate to the approximate loss of 500ml of fluid.

This sort of rough calculation cannot be used when dealing with a possible severe internal haemorrhage, for example a ruptured spleen.

Despite all reservations mentioned above it is recommended that you (as the offshore medic on board)

- Perform a quick calculation of the volume that will be required by looking at the injuries sustained and predicting the loss associated
- Begin your infusion
- Constantly monitor the response of the casualty to your resuscitation attempts

Treatment for hypovolaemic shock

- Stop the bleeding
- ABC's
- O2 resuscitation
- Use of measure to stop bleeding such as pressure points, tourniquet, or Celox
- Good elevation of lower limbs
- Fluid replacement guided by presence or absence of radial pulse
- Transport as quick as possible to shore based hospital

Principles of fluid replacement

- Do not allow the Cannulation process to extend the on-scene time
- Limit to two attempts to cannulate
- If failed two attempts attempt IO access
- Give IV fluids to maintain radial pulse
- Administer normal saline in 250ml boluses to maintain a radial pulse up to a max of 2 litres

- Fluid of choice “Crystalloid”
- In cold weather ensure the IV fluid is warmed to prevent hypothermia

Note: The commonest error with fluid replacement therapy in the management of trauma is under-infusion – prompted by concern to avoid cerebral or pulmonary oedema.

Burns and Hypovolaemic Shock

For a burn area of less than 15% fluid may be replaced orally. However, in cases where there is oral- facial involvement or the burn area is > 15% then you must commence an intravenous infusion.

There are numerous formulae to calculate the volumes of intravenous fluid that needs to be replaced in the first four hours, this is just one example:

The Parkland Formula:

4 ml x % TBSA (total body surface area burned x weight (kg))

For example, a patient with a 20% burn weighing 60 kg would require 4800 ml of Hartmann’s solution administered as follows.

2400 ml of fluid in the first 8 hours @300 ml/hr, then the remaining 2400 ml in the next 16 hours (150 ml/hr)

Infusion type – Crystalloid

Delay in medevac - If there is a possibility of a delay of more than 4 hours in getting your patient back to the beach and the nearest hospital you must consult your topside Doctor regarding infusion fluid type and rate of infusion. A strict fluid balance regime must be adhered to using a chart (input against output) the measurement of urine serves as a particularly valuable indicator of the effectiveness of intravenous fluid replacement.

You should aim for a flow rate of between 30-50mls of urine an hour, to this aim it would be best to catheterise your patient (with their written consent) and after a discussion with Topside. This will facilitate accurate charting of their output.

Question B: Calculate the volume of fluid required in the first 4 hours for an 80kg adult rigger with 20% burns, assuming an ‘insensible’ loss of 100ml per hour.

Dehydration and Hypovolaemic Shock

This condition is normally due to a chronic rather than an acute cause, and hopefully you will have had your patient Medevaced prior to this condition setting in, however it is still worth considering it at this juncture.

Remember that fluid replacement therapy must not only take into account the insensible loss of approximately 2-2.5 litres per 24hrs, but also the clinical losses due to the primary cause, for example, diarrhoea or vomiting.

The above must be still taken into account and you should discuss this with your topside Doctor even though, as we have already said, your patient should by this time be in the helicopter and on their way to a hospital.

Septic Shock

Description

Septic shock is a medical condition as a result of severe infection and sepsis, though the microbe may be systemic or localized to a particular site. It can cause multiple organ dysfunction syndrome (formerly known as multiple organ failure) and death. Its most common victims are children, immunocompromised individuals and the elderly, as their immune systems cannot deal with the infection as effectively as those of healthy adults. Frequently, patients suffering from septic shock are cared for in intensive care units. The mortality rate from septic shock is approximately 25–50%.

Causes

When bacteria or viruses are present in the bloodstream, the condition is known as bacteremia or viremia. If the organisms are particularly virulent, or the host is immunocompromised, then the host organism may develop a condition known as systemic inflammatory response syndrome (or SIRS). Sepsis is a constellation of symptoms secondary to infection that manifest as disruptions in heart rate, respiratory rate, temperature and WBC. If sepsis worsens to the point of end-organ dysfunction (renal failure, liver dysfunction, altered mental status, or heart damage), then the condition is called severe sepsis. Once severe sepsis worsens to the point where blood pressure can no longer be maintained with intravenous fluids alone, then the criteria have been met for septic shock. The precipitating infections which may lead to septic shock if severe enough include appendicitis, pneumonia, bacteremia, diverticulitis, pyelonephritis, meningitis, pancreatitis, and necrotizing fasciitis.

Signs & Symptoms

Septic shock is sometimes referred to as “warm shock” since the toxins lead to peripheral vasodilation. This is an important distinguishable clinical sign.

Management
You should follow the general principles we have already outlined in this module so far. I.V fluid regimes should follow the regime we have already given you for hypovolaemic shock. Specific antibiotic therapy is mandatory; this should however be hospital based. As always you should consult your Topside Doctor as to whether this should be commenced prior to Medivac.

Anaphylactic Shock

Description
Anaphylaxis is a serious allergic reaction that is rapid in onset and may cause death. It typically results in a number of symptoms including an itchy rash, throat swelling and low blood pressure. Common causes include insect bites/stings, foods and medications.

Anaphylaxis can also be described as a rare cause of shock associated with histamine release that leads to massive dilation and 'leakiness' of blood vessels. There may also be respiratory tract problems with laryngeal oedema and bronchoconstriction (stridor, wheeze).

Causes
Anaphylaxis may be precipitated by:

- Blood products
- Medications, including some antibiotics and non-steroidal anti-inflammatory drugs (NSAIDs) like aspirin
- Vaccines
- Insect stings, such a wasps and bees
- Food products such as shellfish or peanuts

Signs & Symptoms

- Central nervous system
    - Light-headedness
    - Loss of consciousness
    - Confusion
    - Headache
    - Anxiety
- Respiratory
    - Shortness of breath
    - Wheezes or stridor
    - Hoarseness
    - Pain with swallowing
    - Cough
- Gastrointestinal

    - Crampy abdominal pain
    - Diarrhoea
    - Vomiting
- Loss of bladder control
- Pelvic pain
- Skin
    - Hives
    - Itchiness
    - Flushing
- Heart and vasculature
    - Fast or slow heart rate
    - Low blood pressure
- Swelling of lips, tongue and/or throat
- Runny nose
- Swelling of the conjunctiva

"The onset is often acute with hypotension and possibly respiratory symptoms as mentioned above."

Management
Firstly, lay the patient flat.

Administer Intramuscular adrenaline via antero-lateral aspect of the thigh.

Age	Initial Dose	Repeat Dose	Dose Interval	Volume	Max Dose
> **12 years and adult:** 1 milligram in 1 ml (1:1,000)	500 micrograms	500 micrograms	5 minutes	0.5 ml	No limit

Second line treatment which is usefully continued up to 48 hours to prevent relapse, consists of Chlorpheniramine (Piriton) by slow intravenous injection – remember to consult your Topside Doctor prior to administering this drug.

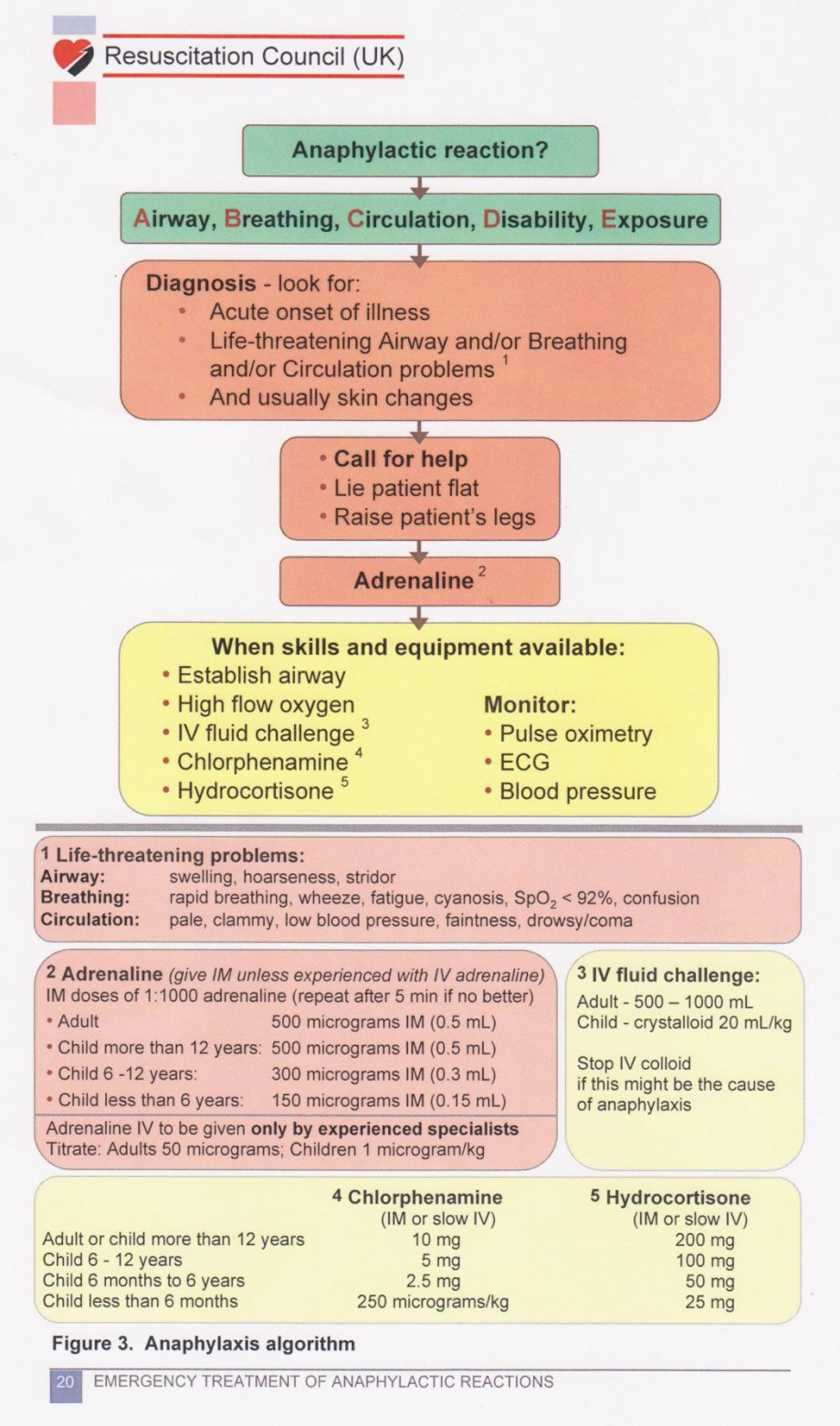


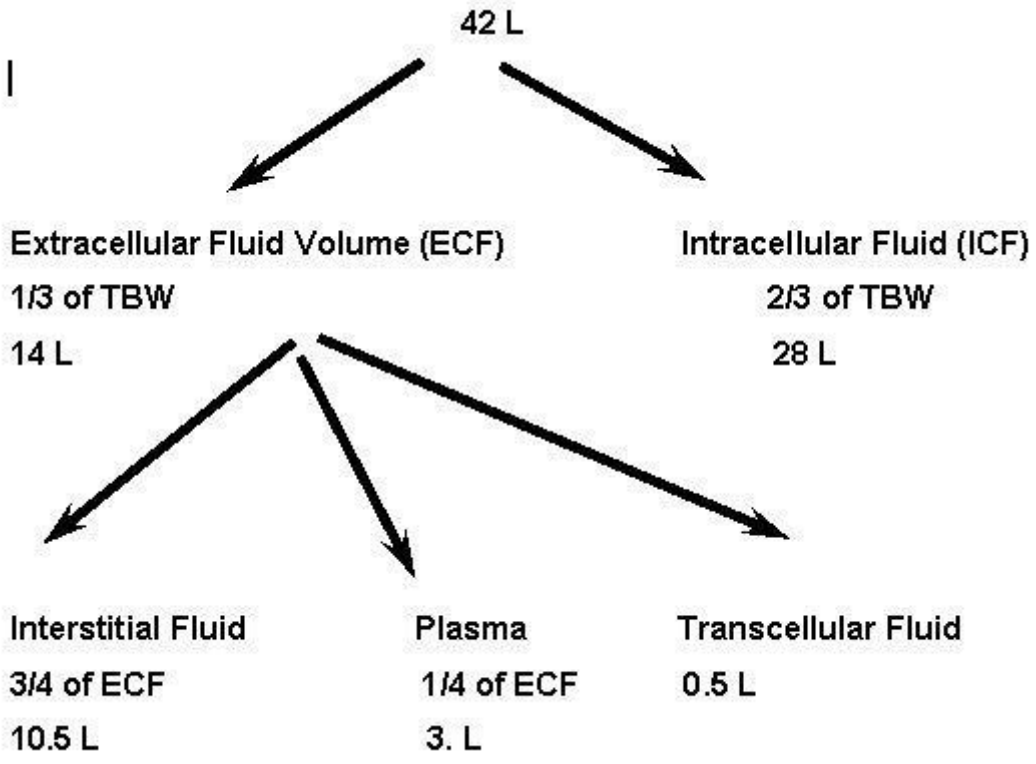
Figure 3. Anaphylaxis algorithm

Note: Some patients or crewmembers are known to be hypersensitive to medications, insect stings or food products. They might be carrying a 'medic alert' or even their own supply of pre-filled adrenaline syringes.

Note: I.V. Adrenaline should never be used in Anaphylaxis

3. Physiology of Body Fluids

Body Composition
Total body water (TBW) constitutes 55-60% of the body weight in young men and 45-50% of the body weight in young women (adipose tissue!!!)
Relationship between the volumes of major fluid compartments. The actual values shown are calculated for a 70 kg man.
TBW = 0.6 x Body Weight



Fluid Compartments
Fluid is distributed around the body either within the cells – Intracellular compartment or outside the cells – this is split between the interstitial compartment and the intravascular compartment.

Fluid Function
Body "water" acts as a universal solvent. This transports glucose, and the chemicals which are essential for life such as electrolytes and proteins, between the various body compartments.

Fluid Movement
This process is affected by:

- Hydrostatic pressure (the hydrostatic pressure within the capillary on the arterial side (Approx 33mgHg) is greater than that of the interstitial space (approx 8 mmHg) the (pushing force) moves fluid from the intravascular to the interstitial space.
- Osmotic pressure: The concentration of solutes within the intravascular space (osmotic pressure 25 mmHg) is greater than within the interstitial space (osmotic pressure 10mgHG) the pulling force from this action returns fluid from the interstitial to the intravascular space.

Arterial capillary
Another complication is that these fluid movements occur across a cell membrane and that cell membrane has an effect on the transport.
It functions not only like a sieve trapping larger molecules but also has (active transport) mechanism which allow the passage of certain molecules, e.g. glucose, (against the current) from low to high concentration.

Let's look at these in greater detail:

Molecular sieve:
Allows free passage of small molecules, such as electrolytes (the crystalloids), according to the forces of hydrostatic and osmotic pressure. Larger molecules, for example proteins such as albumin, (the colloids) are trapped.

Active transport:
This involves preferential movement of specific modules, for example glucose, even against both hydrostatic or osmotic pressures, and usually transported into cells.

Remember that in the context of the physiological process described above:

- Fluid movements are accomplished by the forces of hydrostatic and osmotic pressure acting across a cell membrane, the cell membrane is capable of altering the passage of solutes.
- Body fluids consist of water (the universal solvent) and various other molecules (solutes) dissolved in it.
- Water will accompany the movement of these solutes across cell membranes between the 3 main fluid or body compartments.

4. Pain Relief

Pain due to trauma or MI for example, causes an increased secretion of catecholamines (sympathetic activity) which in turn leads to:

- Vasoconstriction
- Tachycardia
- Anxiety

Effective analgesia, by reversing the changes above, is an essential part of the HSE medic's management to combat shock. There is one other effect, take five minutes to consider what this might be before reading on. Effective analgesia may reduce cardiac "excitability", as well as being of humanitarian benefit.

In your offshore environment in this acute setting you are left with the choices of either:

- Entonox - an inhalation agent of 50% nitrous oxide/50% oxygen mix or
- An intravenous analgesia

Note: Please be aware that Intramuscular agents are of no use in a trauma situation as the injected drug will not be absorbed in a patient who is in shock and peripherally shut down.

On this note there is also a danger of attempting to use further doses to obtain pain relief, this would cause the system to become overloaded. In a case where the condition turns a corner and the patient's resuscitation opens up their peripheral circulation, the high doses would then be washed into the peripheral circulation with the risk of 'analgesic induced collapse'

During a recent military campaign there were several cases of shocked casualties being repeatedly injected with morphine during treatment, because there was no absorption from the intra muscular site. This led to a 'stored' overdose of Morphine. When the casualties were later resuscitated at the field surgical complex, this morphine overdose was flushed into the body.

Inhalation (Entonox)
Inhaled 50% nitrous oxide/50% oxygen by self-administered face mask equipment, incorporating a demand valve, is the first choice for analgesia offshore. This is first choice for the following reasons:

- Rapid onset (within 2 minutes)
- No cardio-respiratory depression
- Increased oxygenation

- Rapidly washed out (within 2 minutes)

Absolute contraindications are as follow:

- Decompression sickness (the nitrogen may increase the size of the bubbles of existing nitrogen in the body)
- Pneumothorax
- It has limited uses in maxillo facial injury or a confused patient as they will not be able to maintain a face mask seal

Situations where it may be especially useful are:

- Casualty extractions
- Stabilisation of fractures (you will be able saturate the casualty prior to moving them)

Intravenous

Morphine and Diamorphine are the IV drugs of choice offshore, some areas store both, others hold morphine alone. These two should be used in aliquots and titrated for effect:

Morphine sulphate 15mg in 1 ml is drawn into a 10ml syringe and diluted with 9ml of sterile water for injection. The solution is then injected in aliquots of 1ml every 30 seconds whilst constantly observing the patient until adequate pain relief has been reached. You should then leave the cannula in situ for ease of access in the event of further medication or fluid resuscitation being required.

Remember: 2mg Morphine is equipotent to 1mg Diamorphine

Where the casualty is in extreme distress an alternative method of administering titrated morphine is as follow: please remember to adhere to all local protocols:

- Give 5ml of the diluted morphine (as discussed above) as a stat dose
- Give further 1ml aliquot per minute as required for effect

Intravenous methods are rapidly effective-caution must be advised due to a number of side effects these include:

- Cardio-respiratory depression (they should not be used on injured personnel suffering from head injuries or where there is significant hypovolaemic or Cardiogenic shock)

- They may induce nausea and/ or vomiting
- Duration of action is 30-60 minutes, action can however be reversed by the use of naloxone, an agent not always found offshore depending on the local policy or supervising physicians formulary.

Always consult your Topside Doctor prior to their usage.

5.Replacement Fluids

There has been controversy over the years regarding the use of colloids and or/crystalloids in the treatment of shock. Whilst the physiology would lead us to believe that the use of colloids would be most effective, this has not been found in the case in vivo.

The recent Cochrane report makes the choice of fluid replacement very clear –

- In profound shock the best fluid to give is cross matched blood
    - Not available in the pre hospital setting
- NEVER give IV glucose in shock
    - Risk of cerebral and pulmonary oedema
- Current recommendations are Crystalloid (Hartman's/Normal Saline) rather than Colloid (Gelofusine/Albumin solutions)

The reason for this advice on the use of crystalloids only is that meta-analysis has shown those treated with colloids do worse, with a 4% increase in mortality over those given crystalloids. This is thought to be due to the greater risk of adverse reactions with colloids.

Key Points:

- Pain relief is an essential part of the management of the shocked casualty
- The clinical signs and symptoms of shock can be related to the pathogenesis
- DO NOT WAIT - ANTICIPATE
- Shock must be anticipated in all cases of trauma or severe illness and effective treatment started before it develops
- Anaphylactic shock is a dramatic and life threatening emergency. You should not delay in using adrenaline

Questions:

Question 1: Define shock

Question 2: What are the physiological terms for these three forces – Pulling force, pushing force and facilitated movement

Question 3: Have a look at the table at the 5 main types of shock and the systems which are at fault when that type of shock occurs, complete the table as shown:

Hypovolaemic	
Neurogenic	
Cardiogenic	
Septic	Combined pump failure
Anaphylactic	

Question 4: State the six clinical signs and symptoms of shock?

Question 5: State the seven principle management actions you should take in the management of shock due to haemorrhage?

Question 6: State the four measures used to arrest haemorrhage

Question 7: Complete the table below with the vital signs you may find in a previously fit adult patient who has sustained a blood loss of 1.5 – 2 litres

Blood pressure	
Pulse rate	
Respiratory rate	>20 per minute
Capillary refill time	
Skin pallor	
Consciousness level	

Question 8: Outline a plan for your intravenous fluid replacement therapy for the last casualty in Q7

Question 9: From the below list complete the table. You may use words more than once.

Neck injury, Wasp sting, Immobilise spine, Stabilise cardiac rhythm, Myocardial infarction, Peritonitis, Adrenaline intramuscular, Elevate legs

Type of shock	**Causes**	**Management**
Neurogenic		
Cardiogenic		
Septic		
Anaphylactic	*Wasp sting*	

Question 10: State the speed of onset, duration of action and contraindications for the below pain relief:

Entonox: ……., 2 minutes, …….

I.V Diamorphine: ……., ……., …….

Questions for your tutor

Answers:

Question A: Try to complete the table below using the 5 types of shock.

System	Problem	Type of Shock
Pump	Myocardial infarction	**Cardiogenic**
Piping	Syncope, spinal cord injury (disruption of sympathetic chain)	**Neurogenic**
Fluid	Haemorrhage	Hypovolaemic
Mixed (fluid and piping)	Sepsis	**Septic**
Mixed (fluid and piping)	Severe allergic reaction	**Anaphylactic**

Question B: ((20% x 80kg) / 2) + (4x100ml) = 1200ml

Question 1: The state when tissue perfusion is inadequate to sustain cellular metabolism

Question 2: Pulling force – Osmotic, Pushing force – Hydrostatic, Facilitated movement - Cell membrane active transport

Question 3:

Hypovolaemic	Fluid
Neurogenic	Blood vessels
Cardiogenic	Heart
Septic	Combined pump failure
Anaphylactic	Combine fluid / pump failure

Question 4: Hypotension, skin pallor, tachycardia, mental changes, tachypnoea, thirst

Question 5: Airway, breathing, oxygen, control of major external haemorrhage, restoration of circulating fluid volume, monitor effectiveness of resuscitative measures, pain relief

Question 6: Direct pressure, indirect pressure, pneumatic splint, tourniquet, artery forceps

Question 7:

Blood pressure	Reduced
Pulse rate	>120
Respiratory rate	>20 per minute
Capillary refill time	>2 seconds
Skin pallor	Pale and clammy
Consciousness level	Drowsy

Question 8: Establish one, preferably two, wide bore cannula. Give 250ml bolus of crystalloid and check for radial pulse. Continue until radial pulse present.

Question 9:

Type of shock	**Causes**	**Management**
Neurogenic	Neck Injury	Immobilise spine
Cardiogenic	Myocardial Infarction	Stabilise cardiac rhythm
Septic	Peritonitis	Oxygen
Anaphylactic	*Wasp sting*	Adrenaline IM

Question 10:

Entonox:

- Within 3 minutes you should get pain relief. When stopped, the effects of the gas will wear off quickly
- ENTONOX should not be used in any condition where gas is entrapped within a body and where its expansion might be dangerous, such as with:
    - artificial, traumatic or spontaneous pneumothorax
    - air embolism
    - decompression sickness
    - following a recent dive
    - following air encephalography
    - severe bullous emphysema
    - use during myringoplasty
    - gross abdominal distension
    - In patients having received recent intraocular injection of gas.
    - Pregnancy: avoid using it during the first and second trimesters of pregnancy.

I.V Diamorphine:

- It will begin working to relieve pain almost instantly, although it reaches its peak effect in **5 to 10 minutes**
- Morphine provides the longest duration of block of those opioids commonly used intrathecally, lasting up to 24 hours in some patients. Diamorphine usually provides post-operative analgesia for **12 hours**.
- Diamorphine is also contra-indicated where there is a risk of paralytic ileus, or in acute diarrhoeal conditions associated with antibiotics
- induced pseudomembranous colitis or diarrhoea caused by poisoning (until the toxic material has been eliminated).

- Suspected or known increased pressure on the brain
- Had any recent alcohol or recreational drugs.