THE NORTHERN HOSPITAL

HEMORRHAGIC SHOCK

U.S. Marine Gunnery Sergeant Jeremiah Purdie instinctively reaches out to assist a fallen comrade during a desperate battle with Communist forces in South Vietnam, 1966. Photographer, Larry Burrows, Time-Life Magazine.

...A four week operation, when each step could mean your last one on two legs:
it was a war within yourself.
But you wouldn't let your mates down 'til they had you dusted off,
so you closed your eyes and thought about something else.

Then someone yelled out "Contact", and the bloke behind me swore.
We hooked in there for hours, then a God almighty roar;
Frankie kicked a mine the day that mankind kicked the moon -
God help me, he was going home in June.

1 can still see Frankie, drinking tinnies in the Grand Hotel

on a thirty-six hour rec leave in Vung Tau.
And I can still hear Frankie lying screaming in the jungle.
Till the morphine came and killed the bloody row

And the Anzac legends didn't mention mud and blood and tears,
and stories that my father told me never seemed quite real
I caught some pieces in my back that I didn't even feel,
…God help me, I was only nineteen…

Redgum, "Only Nineteen", 1983.

The first kick I took was when I hit the ground
You end up like a dog that's been beat too much
Till you spend half your life just covering up

Born in the USA, I was born in the USA,
I was born in the USA, born in the USA.

Got in a little hometown jam
So they put a rifle in my hand
Sent me off to a foreign land,
To go and kill the yellow man…

I had a brother at Khe Sahn
Fighting off the Viet Cong
They're still there, he's all gone

He had a woman he loved in Saigon
I got a picture of him in her arms now…

Bruce Springsteen, "Born in the USA", 1984

…Your friends said that you, a road-builder,
had such love for our country, you rushed
down the trail that night, waving your torch
to save the convoy, calling the bombs down on yourself.

We passed by the spot where you died,
tried to picture the young girl you once had been.
We pitched stones up on the barren grave,
adding our love to a rising pile of stone.

I gaze into the center of the crater
where you died and saw the sky in the pool
of rain water. Our country is so kind:
water from the sky washes the pain away…

Lam Thi My Da, "A Piece of Sky without Bombs".

The so-called "Cold War" between the Soviet Union and the United States lasted from 1945 at the end of the Second World War to the disintegration of the Soviet Union in 1991. Cold in the sense that the two superpowers never engaged in thermonuclear warfare, though they came perilously close during the Cuban Missile Crisis of 1962, this is not say that the period was without its "hot" periods - on the contrary.

Never daring to confront each other directly in the nuclear age, the Superpowers fought each other through proxies across the face of the globe. Their struggle for the domination of the rest of the world was a legacy of the great Nineteenth century intellectual debates between capitalism and Marxism. In the Twentieth century, once the battle between the old world Empires, (the war to end all wars), and the struggle against Nazism and Imperial Japan had been fought, this intellectual debate evolved into armed conflict, once again on a world scale. The United States and the Soviet Union fought each other by proxy across the globe, but principally and most destructively in Korea, Vietnam, and Afghanistan. None of these conflicts proved decisive. The two protagonists fought themselves to a stalemate and in the process brought untold misery to many millions whose misfortune it was to either have their homeland as the focus of conflict, or to be embroiled on one side or the other as ideological allies of one or other of the two nuclear armed superpowers. Unlike the clear naivety of the cause of Empire in the First World War or the righteous moral cause of the Second, the "cause" of the Cold War was not clear at all. To many it seemed like little more than medieval warfare fought purely over ideology, not along religious lines as in past centuries, but on just as equally obscure ideologies of conflicting social philosophies.

All this went to create great uncertainty, anxiety and immense social conflict within the protagonist societies caught up in the conflict. Uncertain of their cause, unrest and violence would break out on the home front with citizens hopelessly divided over just what exactly it was they were supposed to be fighting about. Against this backdrop, the 1960s were a time of immense paradox and enormous social change. Scientific as well as social progress in the second half of the twentieth century had been nothing short of astounding, and the benefit this progress would bring to humanity seemed as if it would have no limit. And yet, the dichotomy remained that while the whole world could stand still as one and watch as a man walked on the Moon, at the very same time countless young men were walking onto minefields. These kinds of contrasts were constantly seen, none better captured than Larry Burrows' poignant and famous image from the Vietnam War, of an African American soldier reflexly reaching out to assist a seriously wounded white comrade in a moment of human compassion amid the horrors of armed conflict. And this was time when extreme racial prejudice of white Americans towards African Americans was still very much alive. Martin Luther King would be assassinated just two years after Burrows (who was killed in Vietnam) took his photograph.

Many lessons came out of the Cold War, the war that took the world to the brink of nuclear annihilation. In the medical field the experience of the Vietnam War brought great advances in the understanding of the resuscitation of the seriously wounded. Among these advances were the importance of timely fluid and blood product resuscitation of the hypovolemic patient.

HEMORRHAGIC SHOCK

Introduction

Hemorrhagic shock is a type of hypovolemic shock that occurs due to blood loss that results in inadequate organ perfusion and tissue oxygenation.

Hemorrhagic shock is a medical emergency and must be recognized **early** to avoid significant morbidity and mortality.

For the purposes of clinical assessment hemorrhagic shock may be divided into four classes of degree. These classes may be used as a *guide* to initial management.

Treatment consists of early fluid and blood product administration and urgent control of any ongoing hemorrhage.

The degree of monitoring and investigation undertaken must be tempered according to the clinical status of the patient and the urgency for which definitive management is required.

Volume resuscitation, whilst extremely important must never be allowed to significantly delay the more definitive measures of treatment.

All Emergency Departments should have a Massive Transfusion Protocol and a dedicated "CODE" to activate it.

Pathophysiology

Hemorrhage is defined as an **acute** loss of circulating blood volume.

Hemorrhagic shock is a type of hypovolemic shock that occurs due to blood loss that results in inadequate organ perfusion and tissue oxygenation.

The normal circulating blood volume:

Although there is wide variation, in *general* terms the blood volume is:

Adults: 7 % of body weight, (a 70 kg male has a circulating blood volume of approximately 5 liters).

Children: 8-9 % of body weight, OR 70-80 mls/kg.

Causes of hypovolemia:

The causes of **hypovolemic** shock can be thought of as those due to fluid (or plasma) loss, which may be external or internal, or those due to blood loss, which may also be external or internal.

1. **Fluid/plasma:**

External:

- GIT, Urinary, Skin

Internal:

- GIT sequestration: Pancreatitis, pseudocysts, ileus, peritonitis.

2. **Blood,** (hemorrhage):

External:

- Blood loss that can be observed from external wounds.

Internal:

- Blood loss that is concealed: GIT, chest, abdomen, bony fractures, retroperitoneum and urinary tract.

Coagulopathy:

Severe injury and hemorrhage results in consumption of coagulation factors and early coagulopathy.

such coagulopathy is present in up to 30% of severely injured patients on arrival at the ED.

Massive fluid resuscitation, additionally will result in the dilution of platelets and clotting factors.

Hypothermia will further aggravate coagulopathies.

Clinical Assessment

The degree of volume loss may be classified into 4 classes.

The patient's acute clinical signs can be correlated with theses classes, as follows:

Classification of hemorrhagic shock: [1]

The following classification is a clinical *guide only*, as a range of variables may also affect individual parameters.

Confounding variables may include:

1. Age.

2. Co-morbidities

3. Medications

   - In particular, warfarin, DOACs or beta-blockers.

4. Injury severity:

   - This may include both the type and its anatomic location.

5. Time lapsed between injury and the initiation of treatment.

6. Pre-hospital treatment already given.

Clinical Parameter	**Class I**	**Class II**	**Class III**	**Class IV**
Blood loss (mls)	< 750 mls	750-1500 mls	1500-2000 mls	> 2000 mls
% Blood volume	< 15 %	15-30 %	30-40 %	> 40 %
Pulse rate	< 100	100-120	120-140	> 140
Pulse pressure	Normal or ↑	↓	↓	↓
Blood Pressure **SP** **DP**	 Normal Normal May get postural drop.	 Normal ↑ Reduced PP overall	 ↓ ↓	 Very low, or unrecordable

Peripheral perfusion *Capillary return* *Extremities color*	Normal (< 2 seconds) Normal	Slow (> 2 seconds) Pale	Slow (> 2 seconds) Pale	Undetectable. Ashen
Respiratory rate	Normal (14-20)	20-30	30-35	> 35
Urine flow (mls/min)	> 30	20-30	10-20	0-10
Conscious state	Normal or mild anxiety	Moderate anxiety	Moderate to severe anxiety/ confused	Confused/ depressed conscious state.

Differential Diagnosis of shock:

Hemorrhagic shock must be distinguished from other forms of shock, which may co-exist.

There are 6 forms of shock:

1. **Hypovolemic.**
2. Cardiogenic.
3. Anaphylactic.
4. Septic
5. Neurogenic
   - Spinal injury
   - Drug induced
6. Addisonian, (a combination of neurogenic shock and fluid loss)

Pre-existing dehydration (hypovolemia) may contribute to the clinical picture.

Cardiogenic shock may co-exist (in the form of myocardial contusion, tension pneumothorax or cardiac tamponade).

Septic shock may co-exist in cases of late presentations.

Neurogenic shock may co-exist exist in cases of high level spinal cord injuries.

Anaphylactic shock may occur due to iatrogenic causes with the administration of drugs to which the patient has a severe allergy to.

Patients with Addison's or suppressed adrenal glands from any cause will respond poorly to attempts at resuscitation, unless corticosteroids are given.

Investigations

The extent and need for investigation will be based on:

- How shocked or unwell the patient is.

And

- The need to localize the source of the bleeding.

The degree of imaging that is undertaken must be tempered by how unwell the patient is.

It may be necessary to forego lengthy investigations and proceed directly to the operating theatre for exploratory laparotomy/ thoracotomy or wound exploration, when a patient is particularly unstable and not responding to resuscitation attempts.

When considering the possible source of *concealed* blood loss the following list should be remembered:

- Chest
- Abdominal cavity
- Retroperitoneum
- Multiple fractures, (in particular, pelvis and femur)

And to a lesser degree:

- Urinary tract
- GIT, (ie bleeding into this).

The following investigations may need to be considered:

Blood tests:

1. FBE:

   - An initial hemoglobin should be requested, (this will primarily act as a baseline observation).

   - Note that initially the hemoglobin may not appear compromised in acute blood loss. Even when massive this level may be only minimally impaired initially.

   - It will fall with ongoing blood loss and/ or large amounts of crystalloid replacement without packed red blood cell replacement.

   - The monitoring of the hemoglobin therefore must be a **dynamic** process.

     This dynamic monitoring is useful not only for determining ongoing blood loss but also for determining the response to treatment.

   An initial normal hemoglobin does not exclude significant blood loss. It is unreliable for estimating acute blood loss and is therefore inappropriate for diagnosing hemorrhagic shock.

2. U&Es/ glucose.

3. Blood group and cross-match:

   - This is done according to the urgency of the case.

4. LFTs

5. Coagulation profile:

   - INR/ PTT/ fibrinogen levels.

   More specialized coagulation tests may also be useful, if available, and help guide management of a coagulopathy.

   These include:

   - Thromboelastography (TEG)

   - Rotational thromboelastometry (ROTEM).

6. Cardiac enzymes.

7. Beta HCG - for women of child bearing age.

8. VBGs/ lactate level:

- Lactic acidosis.

  This may be useful for determining the presence of shock when the clinical picture is unclear, or it may be useful for determining the severity of shock, which may be under-appreciated on clinical assessment alone.

- Most VBG analysers can also provide a quick bedside **Hb** estimation.

ECG:

This should not delay more important measures, however is useful for documenting:

- Previous ischemic heart disease.

- New cardiac ischemia

Plain Radiography:

AXR

Indirect clues of fluid collections may occasionally be gained in certain situations:

- Loss of the psoas shadow, this sign is fairly non-specific and non-sensitive however and should always be interpreted in the light of the clinical setting.

- Bowel displacement may be seen on occasions with larger amounts of intra-abdominal fluid, again this sign is non-specific and non sensitive.

These signs must **not** be relied upon, and are really only of retrospective academic interest.

CXR

Large hemothorax / effusions, (acute hemorrhage into the pleural space may result in hypotension, effusions usually do not)

On a supine CXR:

- Hemothorax / effusion may not be readily apparent. The only clue may be a diffuse haziness of the involved hemithorax when compared to the normal side.

On an erect CXR:

- A much better appreciation of fluid within the hemithorax can be achieved with an erect CXR

Trauma Series

The minimum series in major traumas includes pelvis, chest and cervical spine.

The **pelvis** and **femur** are the most likely **bony sources** of significant blood loss.

FAST scanning:

Focused assessment sonography in trauma (FAST) scan is an invaluable bedside investigation in the setting of traumatic hemorrhagic shock.

It has largely replaced DPL for the detection of intra-abdominal free fluid.

Diagnostic peritoneal lavage, (DPL):

This technique is useful, for those skilled in it use when FAST scanning is unavailable.

CT scanning:

CT scanning, including **CT with contrast and CT angiography** is the most specific and sensitive method of imaging, when trying to locate a source of hemorrhage.

This is the best imaging modality for determining the sight of blood loss in trauma cases, but will not always be appropriate when patients are very unstable, where immediate theater may be more appropriate

It can readily detect blood loss within:

- Chest
- Abdomen
- Complex pelvic fractures
- Retroperitoneal compartment.

Management

1. **ABC:**
    - Airway and breathing/ ventilation management will as always be the initial priorities.
    - IV access and take blood tests.

2. **Control obvious external haemorrhaging:**

- This should primarily be with sterile saline moistened combines **compressed directly** over the wound with firmly bound crepe bandages.

- **Tourniquets** may be used for *initial* control of *severe* limb bleeding and to allow for initial wound assessment

  Tourniquets can be life-saving.

  If a tourniquet is required to be left on for a prolonged period it must be recognized that a choice of life over limb has been made.

See also separate documents on:

- **Arterial Injury (Limb)**

- **Wound Packing**

3. **Trendelenburg position:**

- A useful first aid measure is the Trendelenburg position, (head down and legs elevated), to increase venous return and hence cardiac output.

4. **Establish monitoring:**

All patients should have:

- Pulse oximetry.

  This may however be unreliable where there is significant impairment to a patient's peripheral perfusion.

- Continuous ECG monitoring

- Continuous blood pressure monitoring. Initially this may be by non-invasive means.

  Invasive arterial line blood pressure is desirable in more severe cases, but *should not delay* any more urgent investigations or treatments.

In some cases, (but again these should not delay more urgent investigations or treatments), the following may also be useful:

- Urinary catheter, (providing a urethral injury is not suspected).

  Desirable urine outputs are:

- ♥ Adults: > 0.5 ml/kg/hour.
- ♥ Children: > 1 ml/kg/hour.
- ♥ Children < 1 year of age: > 2 ml/kg/hour.

- A central venous line.

5. **Vascular access:**

Peripheral IV access:

Poiseuille's law states that the rate of flow through a tube is directly proportional to the fourth power of the radius and inversely proportional to the length. Therefore the ideal peripheral cannula for the infusion of large volumes of fluid should be short and large calibre.

A short wide bore catheter of **16 gauge** or more is best, however this may not always be possible and some access is always better than no access.

Two catheters should be placed.

The biggest most available vein in the **upper limb** is preferred, most commonly this will be the **cubital fossa veins.** (A lower limb vein however is better than no vein at all).

IV fluid lines should always be connected to a hand-pump giving device, so that fluids or blood can be pumped through more quickly if necessary.

Specialized rapid infusion devices may also be used to assist the rapid delivery of fluids and blood.

Difficult IV access:

Cases where IV access if difficult or impossible will require either central access, surgical access or osseous access.

Central access:

- Options will include internal jugular, subclavian or femoral.

  Femoral lines have a number of advantages in that they are less invasive, easier and quicker to place and have fewer complications.

Surgical cut-downs:

- This may be an option for those skilled in this procedure, but a central line is generally a better and much quicker option.

Intra-osseous access:

- Specific kits for these are now widely available. This type of access is more commonly used in pediatric age groups, although it can be used in *any* age group.

6. **Volume resuscitation:**

The aim of volume resuscitation is to restore organ perfusion and optimize tissue oxygenation.

Volume replacement will be guided by:

- The initial hemorrhage classification

And

- The patient's response to initial therapy.

Note that fluid resuscitation must be initiated at the earliest signs and symptoms of blood loss or at the earliest suspicion of these, and not when the blood pressure is falling or absent.

Systolic pressure may not fall until as much as 30 % of blood volume is lost, and so is a late sign of hemorrhage.

Any injured patient that has a tachycardia and poor peripheral perfusion should be considered to be in hemorrhagic shock until proven otherwise.

In general terms:

Class 1 hemorrhage:

- Will not require fluid resuscitation.
- This is generally the equivalent to the donation of a unit of blood.

Class II hemorrhage:

- Will require crystalloid resuscitation.

Class III hemorrhage:

- Will require crystalloid administration and a blood transfusion

Class IV hemorrhage:

- Will require **immediate** blood transfusion as this degree of blood loss is immediately life-threatening.

- This will also require the additional blood products of platelets and fresh frozen plasma.

- A **massive transfusion protocol** should be activated.

Initial crystalloid volume resuscitation:

- **One to two liters** for adults and **20 mls/ kg** for children (< 40 kgms) of **crystalloid** is a usual starting point.

- A systolic pressure of at least 90 mm Hg is desirable.

  In cases of blood loss, blood pressures above this are not necessary and may be detrimental because if blood pressure is raised rapidly before hemorrhage has been definitively controlled, increased bleeding may result.

- Colloid solutions have shown no clear benefit over crystalloid solutions, so given the potential complications of colloid, such as allergic reactions, volume overload and acute lung injury, crystalloids are the currently preferred resuscitation fluid.

- Note that for those patients who require rapid administration of large volumes of fluid in the setting of blood loss, a **rapid infusion device** may be used.

- Ongoing fluid requirements should be titrated according to clinical parameters such as pulse, blood pressure, urine output and peripheral perfusion, and hemoglobin levels.

The 3:1 rule:

Administered crystalloid solutions, (**normal saline** or **Hartmann's solution**), are generally distributed as 1/3 within the vascular compartment and 2/3 within the extravascular compartment. From this fact stems the useful 3:1 "rule of thumb"

As a general rule, 3 mls of crystalloid will be required for every 1 ml loss of blood in order to replace the intravascular volume.

As an example:

For a 30 % loss of blood (class III hemorrhage) in a 70 kg person.

= 70 kg x 7 % blood volume = 4900 mls total blood volume.

= 4900 mls x 30 % = 1470 mls blood loss.

Therefore 3 x 1470 mls = 4410 mls of crystalloid will be required, (roughly 4.4 liters in *theory*, however blood should be given before this amount of crystalloid is reached).

Note that persistent attempts to achieve a normal blood pressure are not a substitute for the control of bleeding. Hence fluid resuscitation should never unduly delay time to definitive measures such as surgery.

7. **Blood product administration:**

All Emergency Departments should have a Massive Transfusion Protocol and a dedicated "CODE" to activate it.

Blood:

The aim of blood transfusion is to restore the **oxygen carrying capacity** of the blood, (as opposed to volume restoration that is the role of crystalloid solutions).

Fully cross matched blood is the best option, however in urgent cases this will not be possible.

The type of blood given will depend on the urgency of the clinical situation.

Options will include:

- O negative, (immediate, *for women of child bearing age*)
- O positive, (immediate)
- Type specific (this is ABO and Rh matched), (within 10 minutes)

  Incompatibilities with other antibodies may exist with this blood however.
- Fully cross matched, (within 60 minutes)

Platelets and fresh frozen plasma:

These will be needed in cases of blood loss when there is

- Coagulopathy on laboratory parameters, (this may include patients or pre-existing thrombocytopenia).
- Associated liver disease.
- Class IV hemorrhages, where early administration should be considered.

- There has been a requirement for **"massive" transfusion**:

  Massive transfusion in adults may be *arbitrarily* defined as: [1]

  ♥ Replacement of > 10 units of blood in 24 hours

  Or

  ♥ > 4 units within 1 hour.

  In children as transfusion of > 40 ml/kg (blood volume in children over 1 month old is approximately 80 ml/kg).

  As a guide use the 1:1:1 "unit rule", or 4:4:1 "bag rule"

  (A unit is the number of donors, while a bag is the total amount of pooled blood product that is packaged from one or more donor).

  ♥ **For every 4 units of blood (or more than 40 mL/kg in a child), (note there is one unit to one bag)**

  Give:

  ♥ **Fresh frozen plasma 4 units (each unit approximately 300 mL) or 10 to 20 mL/kg IV, (note there is one unit to one bag).**

  Plus

  ♥ **Platelets 1 pooled "bag" of platelets, (which is 4 "units" of platelets).**

  Consider:

  ♥ **Cryoprecipitate**

  This principally contains fibrinogen, F8, F13, VMF, & fibronectin. It comes in bags of 1 unit of volume about 30-40 mls.

  Cryoprecipitate should also be given if fibrinogen levels are low (less than 1 g/L) when measured.

  In Obstetric haemorrhage, pre-emptive replacement of fibrinogen with cryoprecipitate even at otherwise "normal" fibrinogen levels and a target fibrinogen of > 2.0 grams/L is recommended as the female genitourinary tract has high fibrinolytic activity.

Usual dose is 5-10 units of cryoprecipitate but a double dose may be beneficial if there is rapid blood loss.

Note that platelets are stored at room temperature and are immediately available while FFP units and cryoprecipitate are frozen may take up to 30 minutes to thaw.

8. **Avoidance of hypothermia:**

Hypothermia is a potential hazard in the multi-trauma patient due to the need for complete undressing for full assessment and the administration of large volumes of cool fluids.

Hypothermia can worsen coagulopathy and acidosis.

Hypothermia may be avoided by:

- Passive re-warming with blankets after full assessment has occurred.
- The use of IV **fluid/ blood warmers.**

Crystalloids, (but not blood products) may be pre-warmed in microwave ovens, to a temperature of around 39 degrees.

9. **Assess the response to treatment:**

After the initial fluid bolus, (2 liters in adults and 20 mls/ kg in children) the patient's response should be assessed, (according to the parameters listed above in the classification of the severity of hemorrhage).

Response to initial fluid resuscitation can be:

- Immediate
- Transient
- Minimal or none.

Lack of response to fluid therapy may indicate:

- Ongoing blood loss
- Inadequate fluid administration
- Unrecognized co-morbidity, including other co-existing forms of shock

Actions needed in these groups may be summarized as follows:

Parameter and action required	**Rapid Response**	**Transient response**	**Minimal or no response**
Vital signs	Normalize	Transient improvement only	Remain abnormal
Estimated blood loss	Minimal (<15%)	Moderate and ongoing, (15-40%)	Severe (>40%)
Need for blood	Low	Moderate/ high	Immediate
Blood preparation	Type & cross matched	Type specific	Emergency O negative
Need for operative intervention	Possibly	Likely	Highly likely
Early surgical presence	Yes	Yes	Yes

10. Adjunctive agents:

Tranexamic acid:

In traumatic hemorrhage, mortality can be reduced when tranexamic acid is administered **within 3 hours.**

Note also that within the 3 hour window, the earlier the administration the better. The benefit of tranexamic acid administration decreases by 10% for every 15 minutes of treatment delay until 3 hours after the onset of haemorrhage, when there is no benefit (or possibly increased mortality)

Usual dosing is:

- Loading dose 1000 mg IV over 10 minutes

Followed by:

- 1 gram, (ie 1000 mg) infusion over 8 hours.

Reverse anticoagulation:

Patients on anticoagulants may need urgent reversal of these with specific antidotes, where available.

Vasopressors:

These are **contraindicated** as **first line** agents in hypovolemic shock, as they will worsen tissue perfusion.

Calcium:

Most patients receiving blood transfusions do **not** need calcium supplementation.

When necessary calcium administration should be guided by the **measurement of ionized calcium** levels.

Excessive calcium administration can be detrimental.

Recombinant Factor 7a ("Novoseven"):

If there is ongoing bleeding despite surgical attempt to control bleeding, and appropriate blood product replacement (as reflected by FBE, PT/INR and APTT), there may be a role for recombinant Factor 7a.

Its benefit is also partly dependent on normal temperature, acid-base balance and correction of hypocalcemia and attempts should be made to correct these disturbances.

This drug is unproven, expensive and does not currently have marketing approval for the general treatment of coagulopathy, but there is anecdotal evidence of significant benefit in patients with life-threatening microvascular bleeding despite surgical haemostasis and adequate plasma product and platelet support.

Indication for its use should be confirmed with a specialist **Haematologist**.

Desmopressin (DDAVP):

Usual IV dose is 20 micrograms in 100 mL normal saline over 30 minutes (based on 0.3 micrograms/kg).

DDAVP may improve coagulation function via endothelial release of factor 8 / vWF, and possibly through improved platelet function.

It may be of particular benefit in patients with uraemia / dialysis dependent and in patients with other platelet dysfunction, including von Willebrand's disease but its wider role is uncertain.

Tachyphylaxis occurs rapidly with repeat doses and potential side effects include hyponatremia and fluid retention.

Prothrombinex-VF:

This is **not** recommended currently in massive transfusion unless there is concomitant **warfarin** related over-anticoagulation.

This prothrombin complex concentrate (PCC) contains only Factors 2, 9, 10 and small amounts of unfractionated heparin (UFH) and antithrombin.

Its use in trauma and other massive transfusion scenarios is currently considered investigational only.

11. **Definitive surgical intervention:**

The primary focus of treating hemorrhagic shock is to quickly identify and stop hemorrhage as soon as possible.

Time to definitive surgical intervention will be a critical factor in outcome and this should never be excessively delayed due to ongoing attempts at fluid resuscitation.

12. **Radiological intervention:**

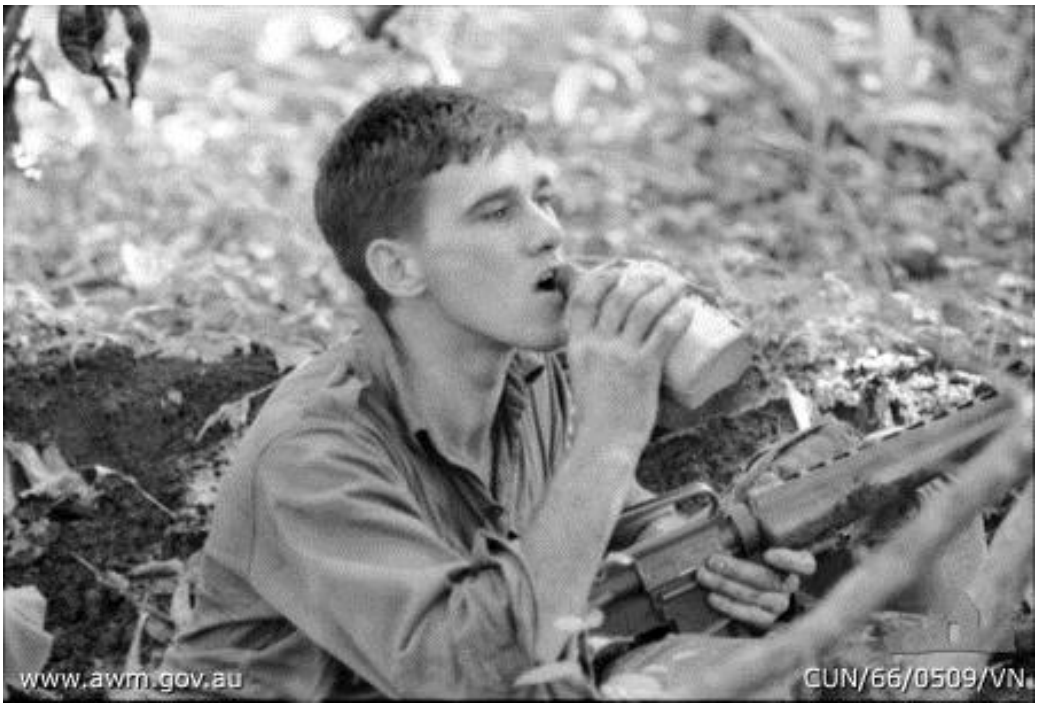
Angiographic embolization techniques may be used when surgical access is difficult or impossible.

Disposition:

Most injured patients who are in hemorrhagic shock require early surgical intervention or angioembolization to reverse the shock state.

The presence of shock in a trauma patient warrants the immediate involvement of a surgeon.

Strongly consider arranging for early transfer of these patients to a **trauma center** when they present to hospitals that are not equipped to manage their injuries.



Paul Large, aged 21 years, killed at Long Tan, August 1966, Archives of the Australian War Memorial Canberra.

…This clipping from the paper shows us young and strong and clean.
And there's me in my slouch hat with my SLR and greens.
…God help me, I was only nineteen…

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2. Australian Red Cross Blood Service: www.transfusion.com.au

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