GIG CYMRU NHS WALES
Rhwydwaith Trawma De Cymru
South Wales Trauma Network

SOUTH WALES TRAUMA NETWORK (SWTN)

CLINICAL GUIDELINE (CG)

DAMAGE CONTROL RESUSCITATION (ADULT MAJOR TRAUMA PATIENTS)

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Sign Off	Network Board

Aims & Scope

The aim of this guideline is to:

- Describe the principles of Damage Control Resuscitation.
- Use of Tranexamic Acid.
- Provide a mnemonic for management of trauma patients with major haemorrhage.

For paediatric guidelines see SWTN CG18.

Introduction

Damage Control Resuscitation (DCR) has drastically changed trauma care in the last decade. The aim is to control bleeding, optimise oxygen delivery and prevent physiological deterioration whilst simultaneously restoring anatomical stability and addressing any coagulopathy.

In a 'shocked' patient the 3 underpinning principles of management of are:

- Immediate temporary control of obvious bleeding – Catastrophic Haemorrhage.
- Clot stabilisation with haemostatic resuscitation.
- Identification and definitive control of all significant sources of bleeding and decompression of extremity compartment syndrome – Damage Control Surgery.

Appendix 1 provides a mnemonic for management of trauma patients with major haemorrhage for display in resuscitation areas (including emergency/trauma theatres and intensive care units).
Appendix 2 give is an example of a Damage Control Surgery, Surgical Pause Form.

Catastrophic Haemorrhage

The immediate application of tourniquets in the presence of significant bleeding from open limb injuries, and pelvic binders for open book pelvic trauma have clearly been shown to improve survival. In more than 90% of cases bleeding in pelvic ring injuries is due to venous injury and will respond well to immediate binding and haemostatic resuscitation.

These methods are temporary means of haemorrhage control and must be replaced with definitive treatment as soon as possible.

Haemostatic Resuscitation

Acute coagulopathy following significant trauma is known to be common-place at admission to hospital and arises directly as a consequence of physiological and biochemical derangement following trauma, including the shock state. It is the focus of significant research and has attracted multiple terms (ACoTS, ATC, TIC, ECT), it will be referred to as ACoTS (Acute Coagulopathy of Trauma Shock) in this guideline.
Coagulopathy in trauma patients is associated with higher mortality, greater incidence of multi-organ dysfunction, higher transfusion requirements and longer ICU and hospital stays so must be treated aggressively.

Transfusion strategies must therefore aim to replace lost blood with the nearest equivalent to whole blood. This affords the patients physiology the best opportunity to ensure tissue perfusion and oxygen delivery, whilst mitigating against the effects of ACoTS.

Haemostatic resuscitation (using hospital protocols - see Appendix 3) will allow the use of equivalent volumes of packed red blood cells and fresh frozen plasma, supported with the

appropriate use of platelets and fibrinogen with haematology advice and use of point of care coagulation testing such as ROTEM or TEG (where available).

Boluses of 250ml of blood products via a warming device to achieve the required level of perfusion is recommended. Target blood pressures are difficult to dictate and depend upon patient injuries (for example head injuries), presence of compressible or non-compressible haemorrhage, time since injury and any pre-morbid patient factors. Adequacy of tissue perfusion can be guided by regular blood gases (lactate, base excess).

Care should be given to keeping ionised calcium levels >1.0mmol/L (usually 10mmol of 10% CaCl with every 'shock pack') and hyperkalaemia should be treated aggressively with insulin and dextrose infusions.

Clot stabilisation using Tranexamic acid (TXA) is of proven benefit in trauma, both in the civilian and military settings. The figure below describes indications for use and doses:

TXA

- Within 3 hours of injury.
- Significant haemorrhage (BP < 90 systolic, pulse >110) OR considered to be at risk of significant haemorrhage (e.g. compensated shock or patients in whom bleeding may restart).

Prescribe as follows:

- 1g TXA given as an IV/IO bolus immediately (if not given pre-hospital already) or 15mg/kg for those below 50kg.
- Followed by 1g TXA in 100ml N saline over 8hrs.

Identification of Bleeding

The duration and depth of hypovolaemic shock influences survival. Occult bleeding must be identified & controlled as soon as possible.

Diagnosis should be based on all features of mechanism, physical examination, laboratory tests and imaging. Blood pressure and heart rate are not reliable indicators of severity of shock in isolation. Particular attention should be paid to significant acidosis/acidaemia in patients presenting following trauma.

Diagnostic imaging is vital when the source of bleeding is not obvious. CT scanning should be regarded as the best option. FAST scanning should never delay access to CT.

Consideration should be given to omitting plain radiographs of the chest & pelvis if CT is immediately available. Such a decision is the responsibility of the trauma team leader.

Remember the arterial phase CT abdomen/pelvis is very useful in identifying intra-pelvic arterial bleeding.

Where CT imaging of other injured regions (such as the facial bones and mandible) is likely to be required for definitive reconstruction then it should be acquired in the same visit to the scanner as the trauma CT scan. This reduces the number of times that the shock trauma patient is transferred to and from the radiology department and allows injuries to be addressed in one visit to theatre where appropriate.

Direct to theatre: In exceptional conditions, the patient may be *in extremis* and proceeding to immediate surgery without advanced imaging may be considered. However, serious consideration should be given to proximity of CT scanner and theatres to the resuscitation room; it is preferable to gain CT images 'en-route' to theatres so that images are available prior to knife to skin.

Other Considerations

Underlying disorders of coagulation, including anticoagulant medication and heritable disorders of coagulation. Use appropriate reversal regimes and/or seek haematology advice.

Hypothermia is a potent cause of coagulopathy. Seek to aggressively maintain normothermia.
All blood products **must** be administered through warming devices capable of rapid infusion and adequate warming at the given rate (rapid infuser devices)

Whilst the primary cause of shock in trauma patients is haemorrhage the approach to damage control resuscitation must include ruling out/treating other causes. In patients apparently refractory to balanced volume resuscitation actively consider;

- Tension pneumothorax – in the severely unstable intubated trauma patient consideration should be given to undertaking finger thoracostomies and deferring formal chest tube insertion until concurrent resuscitation activities have ceased/allow.
- Cardiac tamponade – point of care ultrasound should be considered
- Neurogenic – rare but should be a consideration particularly in patients with refractory hypotension in the context of mechanism and other findings.

Damage Control Surgery

Duration and depth of hypovolaemic shock are independent predictors of mortality. Time must not be wasted and communication between surgeons, anaesthetists & theatres must be clear.

Emergency surgery should aim to stem life-threatening haemorrhage, minimise contamination, decompress compartment syndrome, revascularise arterial injuries, debride (or amputate) and stabilise open fractures.

A decision to re-fill the patient aiming to restore haemodynamic normality and global tissue perfusion must be taken as soon as bleeding is controlled or sooner should there be evidence of

end organ damage. Vasopressors should be avoided in the early phase where hypovolaemia predominates and should certainly not be given without significant efforts to adequately transfuse shocked trauma patients. Vasoactives will become more appropriate following control of haemorrhage and restoration of circulating volume.

Location of Damage Control Surgery

Whilst in patients with obvious ongoing exsanguinating haemorrhage immediate haemostasis with surgical intervention locally is clearly the appropriate action, haemorrhagic shock is a continuum. Patients may respond to volume resuscitation with no further evidence of ongoing haemorrhage or may respond but subsequently deteriorate over a longer period of time.

The success of surgical control will depend on timeliness and expertise as well as adherence to damage control rather than definitive management principles. The wider range of specialties, wider range of immediate access to all blood products and timeliness of access to theatres, particularly out of hours **may** mean that in some instances transfer to the MTC rather than local surgical management is the better approach.

The decision of where and when to undertake surgery is dynamic, and dependent on the following;

- Response to damage control resuscitation
- Time to availability of senior surgeon, senior anaesthetist and fully staffed theatre at the time of decision
- Amenability to interventional radiology/combined (hybrid) approach.
- Anatomical location of haemorrhage and expertise available to manage

Patients receiving local damage control surgery should be transferred to the MTC as soon as possible after adequate control and physiological stability has been achieved.

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Appendix 1:

TRAUMATIC mnemonic (expand, print and display in resuscitation areas including emergency/trauma theatre and intensive care units)

South Wales Trauma Network

Serving the Population of South Wales, West Wales & South Powys

The aim of the South Wales Trauma Network is to enhance patient outcomes and experience, across the entire patient pathway from the point of wounding to recovery and includes injury prevention.

Our mission statement: 'Saving Lives, Improving Outcomes, Making a Difference'

Has your adult patient suffered major trauma or major haemorrhage? If yes, then...

T	Tranexamic Acid	• **Initial 1g bolus:**
		  • Often already given pre hospital
		  • Otherwise, administer only if within 3 hours of injury or ongoing hyperfibrinolysis
		  • Do not delay, every minute counts
		• **Subsequent 1g infusion over 8 hours**

R	Resuscitation	• Activate Major Haemorrhage Protocol
		• Transfuse 1:1 RBCs:Plasma and consider early platelets and fibrinogen
		• Consider:
		  • Rapid infuser and cell salvage / Time limited hypotensive resuscitation
		  • Pelvic binder / splint fractures / tourniquet
		• **Avoid any crystalloid use**

A	Avoid Hypothermia	• **Target temperature >36°C**
		  • Increase ambient theatre temperature
		  • Remove wet clothing and sheets
		  • Warm all blood products and irrigation fluids
		  • Warm the patient using forced-air warming device / blanket / mattress

U	Unstable? Damage control surgery	• **If unstable, coagulopathic, hypothermic or acidotic, perform damage control surgery of:** • Haemorrhage control, decompression, decontamination and splintage • **Time surgery aiming to finish < 90 minutes and conduct surgical pauses at least every 30 minutes**
M	Metabolic	• **Perform regular blood gas analysis** • **Base excess and lactate guide resuscitation** • Adequate resuscitation corrects acidosis • **If lactate > 5mmol/L or rising, consider stopping surgery, splint and transfer to ICU** • **Haemoglobin results are misleading**
A	Avoid Vasoconstrictors	• **Use of vasoconstrictors doubles mortality** • However, use may be required in cases of spinal cord or traumatic brain injury • **Anaesthetic induction – suggest Ketamine** • Maintenance – When BP allows, titrate high dose Fentanyl and consider Midazolam
T	Test Clotting	• **Check clotting regularly to target transfusion:** • Laboratory or point of care (TEG / ROTEM) • **Aim platelets > 100 × 10^9/L** • **Aim INR & aPTTR ≤ 1.5** • **Aim fibrinogen > 2g/L**

I	Imaging	• **Consider:**
		  • CT: Most severely injured / haemodynamically unstable patients gain most from CT
		  • Interventional radiology

C	Calcium	• **Maintain ionised Calcium > 1.0 mmol/L** • Administer 10mls of 10% Calcium Chloride over 10 minutes, repeating as required • **Monitor Potassium and treat hyperkalaemia with Calcium and Insulin / Glucose**

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Appendix 2:

Example of Damage Control Surgery – Surgical Pause Form

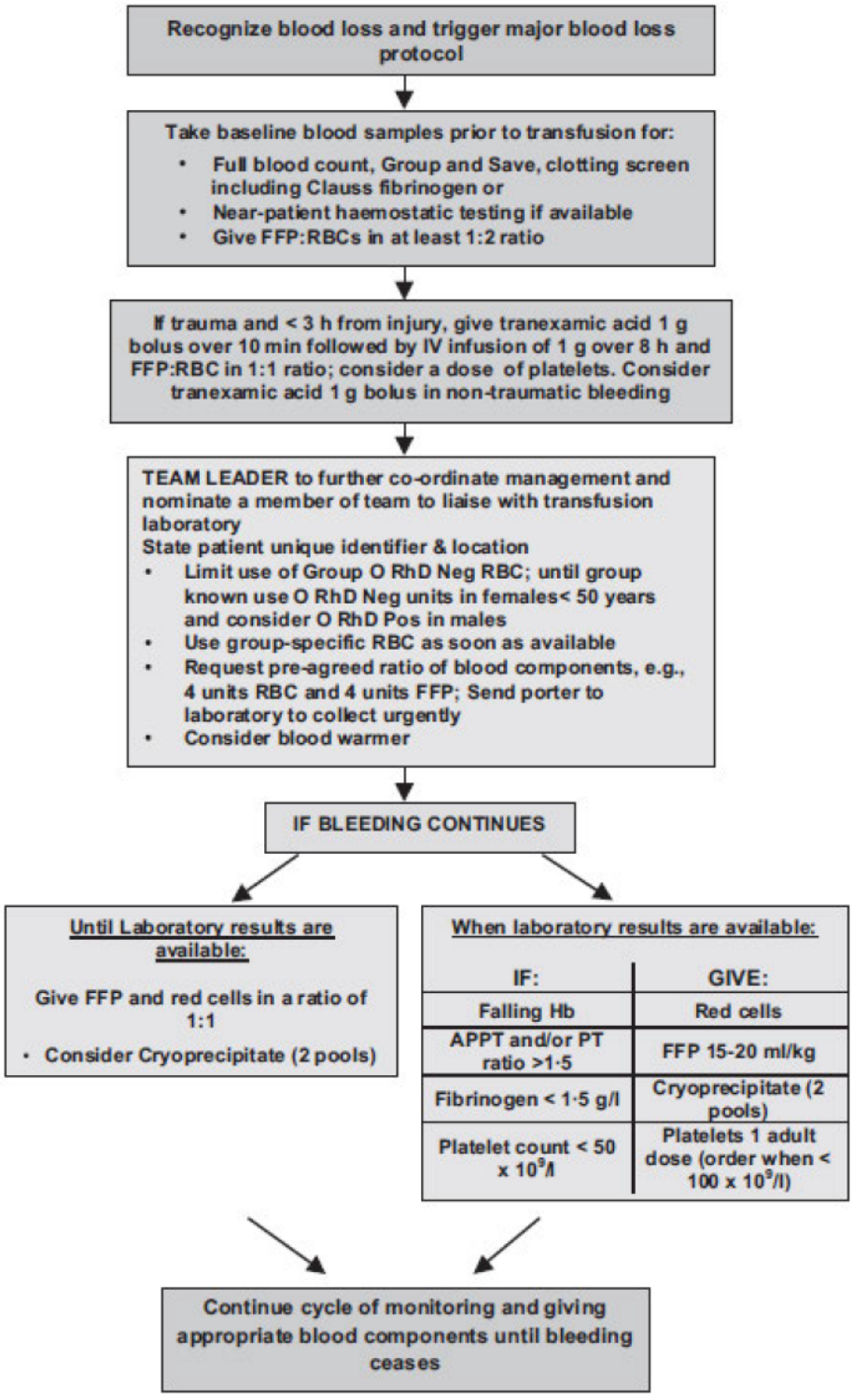
T	R	A	U	M	A	T	I	C

DAMAGE CONTROL SURGERY – SURGICAL PAUSE FORM

At Time Out:	Resuscitation Team Leader:		
Lead Anaesthetist:		Lead Surgeon:	
Injuries:	Surgical Plan:	Patient Temp: °C	
		ABG Results:	
Refer to TRAUMATIC Principles		pH	
Yes / No - MHP activated?		Lactate	
Yes / No - Blood products available?		Base Excess	
Yes / No - Belmont / Cell Salvage required?		Hb	
Yes / No - Patient warming in place?		Calcium	
Yes / No - Tranexamic acid bolus and infusion administered?		Glucose	
Time 0	**Time:_____:_____**	**START THE CLOCK**	
30 Minutes	**Time:_____:_____**		
Surgical Plan:	Patient Temp: °C	pH	
		Lactate	
		Base Excess	
Yes / No - 1:1 Red cells:Plasma +/- Platelets/Fibrinogen or targeted to clotting results		Hb	
Yes / No - Blood products available?		Calcium	
Yes / No - To continue DCS?		Glucose	
60 Minutes	**Time:_____:_____**		
Surgical Plan:	Patient Temp: °C	pH	
		Lactate	
		Base Excess	
Yes / No - 1:1 Red cells:Plasma +/- Platelets/Fibrinogen or targeted to clotting results		Hb	
Yes / No - Blood products available?		Calcium	
Yes / No - To continue DCS?		Glucose	
90 Minutes	**Time:_____:_____**		
Surgical Plan:	Patient Temp: °C	pH	
		Lactate	
		Base Excess	
Yes / No - 1:1 Red cells:Plasma +/- Platelets/Fibrinogen or targeted to clotting results		Hb	
Yes / No - Blood products available?		Calcium	
Yes / No - To continue DCS?		Glucose	

Appendix 3:

Example of Hospital Massive Haemorrhage Protocol (MHP)



Reference: British Society of Haematology; 2015; Major Haemorrhage Guidelines