Managing the Bleeding Patient

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Causes of Massive Hemorrhage

Patient Factors:
- Normal hemostatic system?
- Drugs: Warfarin, Plavix, ASA, other anti-platelet agents.

External Factors:
- Trauma, surgical bleeding, environment
Massive Transfusion Protocol

An algorithm to assist clinicians in the management of severe or massive hemorrhage.
Massive Transfusion Protocol

Helps clinicians to:
1. “Remember” to give products in the right ratio.
2. Optimize hemostasis “aids”
3. Communicate and evaluate
Who are Involved

Physicians:
- Anesthesiologist / Surgeon
- Emergency Physician
- GI Specialist
- Clinical Hematologist
- Internist
- Interventional Radiologist
Who are Involved

**Nursing Staff:**
ER Nurses, Floor Nurses, OR Nurses, ICU nurses

**Laboratory Staff:**
Blood Bank Personnel

**Perfusion Services:**
Cell saver, rapid transfuser

**Hospital Services:**
Porter Services
Basic Principles

➢ Control any obvious sources of bleeding.
➢ Keep the patient normovolemic.
➢ Maintain adequate hemodynamics.
➢ Replace oxygen carrying capacity as necessary.
➢ Replace clotting factors, platelets, fibrinogen.
➢ Reverse correctable factors (heparin, warfarin)
Testing

Point of care testing is most helpful.

- ABG (Hgb, Hct, pH, PaO2, Lytes, Lactate)
- TEG (thromboelastograph)
- PTT, INR, CBC – not available CDHA

Central Lab:
CBC, PTT, INR, Fibrinogen
Thromboelastography

Available at http://vam.anest.ufl.edu/wip.html
Calcium

Very important to maintain adequate ionized calcium levels.
Calcium is “Factor IV” in the clotting cascade (both pathways)
Rapid administration of citrated products quickly overwhelms the liver.
Calcium gluconate (peripheral) or calcium chloride (centrally).
Clotting Cascade

Intrinsic Pathway
- Factor XI → Factor Xa
- Factor Xa → Factor IXa
- Factor IXa → Factor VIIIa
- Factor VIIIa → Factor X
- Factor X → Factor V
- Factor V → Prothrombin (II)
- Prothrombin (II) → Thrombin
- Thrombin → Factor VIIIa
- Factor VIIIa → Factor IXa
- Factor IXa → Factor VIII

Extrinsic Pathway
- Vascular injury → Tissue factor
- Tissue factor → Factor VII
- Factor VII → Factor VIIa
- Factor VIIa + Ca++ → Factor IX
- Factor IX + Ca++ → Factor X
- Factor X + Ca++ → Factor V
- Factor V + Ca++ → Prothrombin (II)
- Prothrombin (II) → Thrombin (Ila)
- Thrombin (Ila) + Ca++ → Factor XIII
- Factor XIII + Ca++ → Factor XIIIa
- Factor XIIIa + Ca++ → Fibrin (cross-linked)
- Fibrin (cross-linked) → Fibrinogen

Final Common Pathway
- Fibrinogen → Fibrin
- Fibrin → Factor XIIIa
- Factor XIIIa + Ca++ → Fibrin (cross-linked)

Ca++
Temperature

- “Cold Blood Doesn’t Clot”!
- Even when everything is done correctly it can be difficult to maintain normothermia.
- Much easier to keep the patient warm then to warm them up.
- Aim to maintain temp > 35° C.
Why Do Patients Get Cold

- Rooms are kept cool for staff comfort
- May have been outdoors (trauma)
- Exposed tissues
- Wet clothes / drapes
- Room temperature IV fluids
- Blood / plasma comes out of the fridge at 2-4 degrees Celsius.
Warming Fluids

Hotline

Level1 Rapid Transfuser
Warming the Patient
Massive Hemorrhage

Have to be able to give fluids quickly.

- On the ward, a “rapid transfusion” is a unit of blood over 2-3 hours.
- In the OR, a rapid transfusion take 2 to three minutes. Can give faster than you can check.
- Bleeding from the aorta is 5 L/min (not for long though, as all bleeding stops eventually).
Blood Salvage

In the operative setting the use of a cell saver can reduce the number of allogeneic units required.

Washes away EVERYTHING but the red cells. Can lead to a coagulopathy as factors / platelets are washed away.
Pharmacologic Therapy

Antifibrinolytics:
- Tranexamic acid
- Aprotinin
- ε-Aminocaproic Acid
- DDAVP
The “Big Guns”
IV Pharmaceuticals

rFVIIa:
One MILLION dollars / kg
Dosing, timing, effectiveness debatable.

Fibrinogen:
Less expensive, useful in hypofibrinogenemic states.

Octaplex: Only to be used for emergent Warfarin reversal. Not indicated in massive transfusion situations.
Topical Agents

FloSeal

Tisseel

Nu-Knit
“Grapeshot Approach”
Organized Chaos

1. Massive hemorrhage is an emergency situation.
2. Frequently little time to wait for lab tests.
3. Treatment is individualized.
   - Clinical scenario
   - Patient factors / pre-existing factors
Organized Chaos

4. Aim for good communication with the “Blood Bank” (Techs, Hematology)
5. Frequently reassess the situation
6. **Stay ahead**: Temperature, calcium, pH, products, hemodynamics, correctible causes.