APPROACH TO HEMORRHAGIC SHOCK

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For the patient with shock due to blood loss

PLAN FOR CONTROLLING HEMORRHAGE & ACTIVATE MASSIVE TRANSFUSION PROTOCOL

- Activate **massive transfusion protocol**
- Determine how hemorrhage can be controlled (surgical, IR, or GI intervention) and ***call for help*** from the appropriate team(s)

USE THE RIGHT LINES AND EQUIPMENT

- Don't wait for central access to begin resuscitation; often PIVs are superior for resuscitation anyway
- Use a pressure infuser/heater to give product faster

USE BLOOD PRODUCTS IN A BALANCED RATIO

- Initially, perform hemostatic resuscitation with blood products in a fixed ratio, e.g. 1 RBC/1 FFP/1 platelet
- Goal is to provide an overall balanced resuscitation (but don't wait for a particular product to resuscitate)
- Use hemodynamic stability (not hematocrit) as the resuscitation endpoint.
- Can use CBC, coags, or TEG/ROTEM to guide additional resuscitation (see OnePager on TEG)

Reassess continuously

Other considerations

CONSIDER TXA

- Effective in trauma (w/i 3 hours), surgical, or obstetrical hemorrhage. Also epistaxis, hemoptysis . **Not** indicated for SHD, ICH, or GI bleed.
- Initial dose 1g IV /10 min

CORRECT COAGULOPATHY

- Reverse anticoagulation depending on agent: warfarin, DOACs, heparin, etc (protocol)
- If platelet dysfunction -> ddAVP 0.3 mcg/kg IV over 30 min

USE PHYSIOLOGICAL FLUID

- If fluids are required (in addition to blood products) use LR or other physiologic solution to avoid acidosis due to hyperchloremia

MAINTAIN EUTHERMIA

- Hypothermia inhibits clotting.
- Warm resuscitation fluids; apply warming to patient if possible

CORRECT ELECTROLYTES

- Hypocalcemia is particularly common due to resuscitation with citrate containing blood products.

VOID ACIDOSIS

- Acidosis inhibits clotting & decreases contractility.
- Provide sufficient MV to correct metabolic acidosis. Goal pH >7.2

Think about the physics!

CATHETER RADIUS

Radius is the most important factor that determines flow rate; Wider is better

CATHETER LENGTH

Shorter is better; PIVs are shorter than central lines and often achieve faster flow rates. PICCs are useless for resuscitation.

$$Flow\ rate \propto \frac{r^4\ \Delta p}{L\quad \eta}$$

PRESSURE DIFFERENCE

Maximize the ΔP by using a pressure infuser (either a **pressure bag**, or better yet, **a rapid infuser system**); can increase infusion rates by up to 3x!

VISCOSITY OF FLUID

Viscosity depends on the temperature of the fluid; Use a **fluid warmer** (which is part of a rapid infuser system) and ***make sure it is actually working***!

EXTENSIONS/CONNECTORS

Each additional connection can reduce flow by up to 30%.
Remove caps, connectors, and extra extension sets.

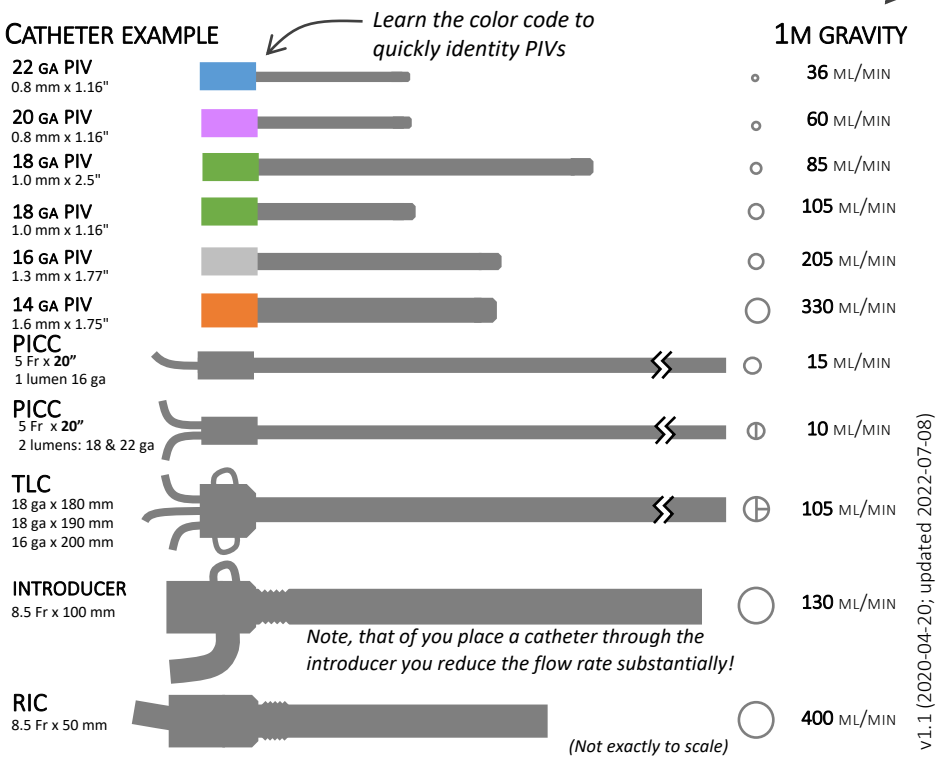
INTRAOSSEOUS

Flow determined by bone location more than needle.

- Tibial is comparable to long 18 gauge PIV
- Humeral is comparable to long 16 gauge PIV

Typical flow rates = 50-100 ml/min w/ pressure infuser.

*Increase **up to 3x** by applying 300mmHg of pressure*



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