A Case for Individualized Care in the ICU Setting

# Blood Loss Management in Surgical ICU: How Severe is the Patient's Anemia?

Confidently Identify and Manage Anemia With Direct Blood Volume Analysis (BVA)

Tony, 31 years old

## Presentation

Intra-abdominal blood loss estimated at 2 L during Roux-en-Y cyst-jejunostomy for chronic/recurrent pancreatic pseudocyst, identified based on postoperative hypotension, lethargy, and tachycardia

## History and Data

- Pancreatitis secondary to gallstones and/or substance abuse, hypertension, gastroesophageal reflux disease; drainage of ruptured pseudocyst and gall bladder removal 15 months ago, followed by sepsis, recurrence, cyst gastrostomy
- Preoperative medications included irbesartan, metoprolol, and hydrochlorothiazide

| BP 79/40 | Hct 20% | BUN 15 | Cr 1.0 | Weight 235 lb | Height 71" |
|---|---|---|---|---|---|

## Status

Over 1 L clotted blood was evacuated from abdomen the day following jejunostomy with 1 unit packed red blood cells (RBC) infused intraoperatively

3D
Determine.
Diagnose.
Decide.

Unlock answers with BVA

## A BVA is Performed to Help Optimize Fluid Management

### Blood Volume Analysis Results

| | BVA Result | Patient Ideal | Deviation From Ideal | Excess/Deficit % |
|---|---|---|---|---|
| Total Blood Volume | 5479 mL | 6206 mL | -727 mL | -11.7% Mild Deficit |
| Red Blood Cell Volume | 997 mL | 2516 mL | -1519 mL | -60.4% Extreme Deficit |
| Plasma Volume | 4482 mL | 3690 mL | +792 mL | +21.5% Moderate Excess |

*Blood Volume Interpretation Guideline*

| | Normal | Mild | Moderate | Severe | Extreme |
|---|---|---|---|---|---|
| BV, PV Deviation (± %): | 0 to 8 | >8 to 16 | >16 to 24 | >24 to 32 | >32 |
| RCV Deviation (± %): | 0 to 10 | >10 to 20 | >20 to 30 | >30 to 40 | >40 |

### Additional Analysis

**Hematocrit Analysis**

| | Patient Result | Normal Male |
|---|---|---|
| Peripheral Venous Hct | 20% | 40-46% |
| Normalized Hct (nHct) | 18% | 40-46% |

### BVA Reveals Extreme Anemia With a -60.4% Red Blood Cell Volume (RBCV) Deficit Despite Having Received 1 Unit of Packed Red Cells

- This degree of depletion is also expressible as a normalized Hct of 18%
- Mild total blood volume (TBV) deficit is driven by extreme RBCV deficiency
- The moderate plasma volume (PV) excess observed is likely due to IV fluid administration

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# Direct BVA Can Help Guide Individualized Care in Surgical ICU

Fluid Management Strategy Based on BVA Results

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- 2 units of packed RBCs given and carefully assessed for evidence of acute kidney injury; as his TBV remains stable, subsequent RBC monitoring is done via change in Hct
- Tachycardia subsides immediately; albumin levels are normal (3.5 g/dL) at 4 days after surgery
- Antihypertensive medication is resumed slowly and cautiously with close attention to systolic pressure and renal function
- 3-week follow-up shows marked improvement in pancreatitis and complete resolution of previous observed large pancreatic pseudocyst

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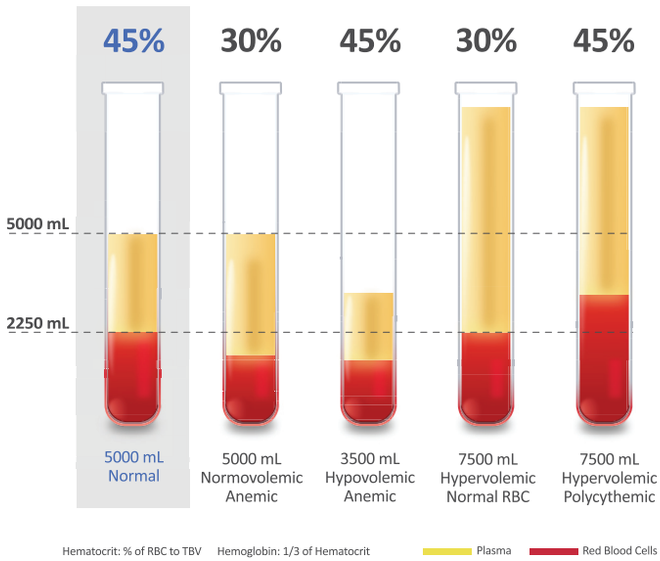
## Managing Blood Loss in Surgical ICU: the Need for Individualized Care

### Volume Derangement Confounds Assessment of Anemia by Hct[1,2]




Courtesy of Mihae Yu, MD, FACS (adapted).

- Acute plasma expansion due to IV fluid administered in the OR may result in a normal or near-normal Hct that masks a significant RBCV deficit
- Acute blood loss may likewise confound Hct: the same Hct result will indicate a greater RBCV deficit in a more hypovolemic patient
- Unlike Hct, direct BVA will quantifies RBCV precisely even in volume-deranged settings[3]

Not an actual patient.

**References:** 1. Takanishi DM, et al. Peripheral blood hematocrit in critically ill surgical patients: an imprecise surrogate of true red blood cell volume. Anesth Analg 2008;106:1808–1812. 2. Feldschuh J. Blood volume measurements in critical care. Ch. 25 in Givetta, Taylor & Kirby's Critical Care, ed., Gabrielli A, et al. Philadelphia, PA: Lippincott, Williams & Wilkins; 2009 (4th ed.), pp 283-295.3. Dworkin HJ, et al. Comparison of red cell and whole blood volume as performed using both chromium-51–tagged red cells and iodine-125–tagged albumin and using I-131–tagged albumin and extrapolated red cell volume. Am J Med Sci 2007;334(1):37-40.

**CONTACT**
**Phone: 865-425-0555 | Toll free: 866-548-7282**
**Fax: 865-425-0551 | info@daxor.com**
**daxor.com**

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