Patient Blood Management
Preoperative assessment
A coordinated multidisciplinary multimodal perioperative patient blood management program is required for implementation (R1, PP1, S3.1)
What does a PBM preoperative assessment look like?
Order of events/structure

- Surgical decision is made →
- Followed by →
  - Preoperative assessment
    - Can patient wait 2-4 weeks (preferred vs less than one week if emergency) for surgery?

**Yes**: Timing of surgery is coordinated with successful optimisation of iron and RBC stores

**No**: Either postpone surgery till patient optimised or do the best you can preop toward preparation and then follow immediately post op (HX: fastest prep that is adequate 5 days)
Who will do the assessment?

- Patient Blood Management coordinator
- Anaemia clinic
- Pharmacist
- GP
- Pre anaesthesia clinic
Alternative approaches

- Develop a team of PBM/anaemia specialists
  - Pharmacy, anaesthesia, advanced practice RN vs. RN
- Anaemia clinic
  - Staffed by above?
- Pharmacy on call for the shift to cover anaemia/iron deficiency consults
- Inclusion / exclusion criteria for bouncing on from preoperative clinic to further anaemia treatment and assessment before finishing preop prep
- One staff to do preop evaluation with post op follow through
Evaluation (non-cardiac)

- Preferably: fasting (no nutritional supplements that include iron for 24-48 hours. No food for 8 hours)
- Full FBC
  - Including MCV, MCH, RDW
- Serum iron (preferred fasting)
- Transferrin saturation
- Ferritin
- CRP
Evaluation (cardiac surgery)

- Preferably: Fasting (no nutritional supplements that include iron for 24 - 48 hours. No food for 8 hours)
  - FBC (with platelets)
  - Serum iron
  - Transferrin
  - Ferritin
  - Iron saturation
  - GFR
  - Creatinine
  - CRP
Preoperative haemoglobin assessment and optimisation template

This template is for patients undergoing procedures in which substantial blood loss is anticipated such as cardiac surgery, major orthopaedic, vascular and general surgery. Specific details, including reference ranges and therapies, may need adaptation for local needs, expertise or patient groups.

Preoperative tests
- Full blood count
- Iron studies including ferritin
- CRP and renal function

Is the patient anaemic?
Hb <130 g/L (male) or Hb <120 g/L (female)

NO

Ferritin <30 mcg/L
- Consider iron therapy if anticipated postoperative Hb decrease is ≥30 g/L
- Determine cause and need for GI investigations if ferritin is suggestive of iron deficiency <30 mcg/L

Iron deficiency anaemia
- Evaluate possible causes based on clinical findings
- Discuss with gastroenterologist regarding GI investigations and their timing in relation to surgery
- Commence iron therapy

YES

Ferritin 30–100 mcg/L
- CRP
  - Raised
  - Normal

Possible iron deficiency
- Consider clinical context
- Consider haematology advice or, in the presence of chronic kidney disease, renal advice
- Discuss with gastroenterologist regarding GI investigations and their timing in relation to surgery
- Commence iron therapy

Ferritin >100 mcg/L
- Possible anaemia of chronic disease or inflammation, or other cause
  - Consider clinical context
  - Review renal function, MCV/MCH and blood film
  - Check B12/folate levels and reticulocyte count
  - Check liver and thyroid function
  - Seek haematology advice or, in the presence of chronic kidney disease, renal advice

No anaemia: ferritin <100 mcg/L
- Consider iron therapy if anticipated postoperative Hb decrease is ≥30 g/L
- Determine cause and need for GI investigations if ferritin is suggestive of iron deficiency <30 mcg/L

# Iron therapy

**Oral iron** in divided daily doses. Evaluate response after 1 month. Provide patient information material.

**IV iron** if oral iron contraindicated, is not tolerated or effective; and consider if rapid iron repletion is clinically important (e.g. <2 months to non deferrable surgery).

**NOTE:** 1 mcg/L of ferritin is equivalent to 8–10 mg of storage iron. It will take approximately 165 mg of storage iron to reconstitute 10 g/L of Hb in a 70 kg adult. If preoperative ferritin is <100 mcg/L, blood loss resulting in a postoperative Hb drop of ≥30 g/L would deplete iron stores.

In patients not receiving preoperative iron therapy, if unanticipated blood loss is encountered, 150 mg IV iron per 10g/L Hb drop may be given to compensate for bleeding related iron loss (1 ml blood contains ~0.5 mg elemental iron).

### Abbreviations

CRP = C-reactive protein  
GI = gastrointestinal  
Hb = haemoglobin  
IV = intravenous  
MCV = mean cell/corpuscular volume (fL)  
MCH = mean cell/corpuscular haemoglobin (pg)

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**Footnotes:**

1. Anaemia may be multifactorial, especially in the elderly or in those with chronic disease, renal impairment, nutritional deficiencies or malabsorption.

2. In an anaemic adult, a ferritin level <15 mcg/L is diagnostic of iron deficiency, and levels between 15–30 mcg/L are highly suggestive. However, ferritin is elevated in inflammation, infection, liver disease and malignancy. This can result in misleadingly elevated ferritin levels in iron-deficient patients with coexisting systemic illness. In the elderly or in patients with inflammation, iron deficiency may still be present with ferritin values up to 60–100 mcg/L.

3. Patients without a clear physiological explanation for iron deficiency (especially men and postmenopausal women) should be evaluated by gastroscopy/colonoscopy to exclude a source of GI bleeding, particularly a malignant lesion. Determine possible causes based on history and examination; initiate iron therapy; screen for coeliac disease; discuss timing of scopes with a gastroenterologist.

4. CRP may be normal in the presence of chronic disease and inflammation.

5. Consider thalassaemia if MCH or MCV is low and not explained by iron deficiency, or if long standing. Check B12/folate if macrocytic or if there are risk factors for deficiency (e.g. decreased intake or absorption), or if anaemia is unexplained. Consider blood loss or haemolysis if reticulocyte count is increased. Seek haematology advice or, in presence of chronic kidney disease, nephrology advice.


**Disclaimer**

The information above, developed by consensus, can be used as a guide. Any algorithm should always take into account the patient’s history and clinical assessment, and the nature of the proposed surgical procedure.
Elements of a preoperative anaemia management program

Know when to refer back to the GP or a specialist:

- Unidentified source of chronic blood loss
- Anaemia secondary to previously unrecognised co-morbidity
- Refer to haematologist for additional evaluation
- Anaemia where initial evaluation does not reveal cause
- Anaemia associated with abnormal cells in the peripheral smear
- Anaemia with leucopenia and/or thrombocytopenia
- Haemolytic anaemia.
Evaluating the patient

Review the clinical history, the type of Surgery patient is having:

- Possible amount of blood loss expected
- Possible sources of recent blood loss
- Clinical conditions associated with chronic anaemia
- Daily medication and nutritional supplement routine
- Previous treatment for anaemia
- Review the FBC and other laboratory results
- Review abnormalities in WBC and platelets
- Make treatment decision.
Preoperative autologous blood donations?
Preoperative autologous donation (PAD) is **NOT** recommended

- Expensive – high cost of procurement, processing, wastage, and discarding
  - Only 1 of every 2 donated units transfused
- PAD blood is banked and carries same risk of clerical error or misidentification as all banked blood
- Units of PAD blood have same functional impairments as other cold-stored blood


Preoperative autologous donation (PAD) is NOT recommended

- PAD blood may not help patients avoid exposure to allogeneic blood
  - More than 50% of patients who undergo PAD arrive anaemic, and iron deficient the day of surgery and require reinfusion of autologous blood as well as allogeneic transfusion to tolerate surgery


Why are we so concerned about preoperative iron deficiency with or without anaemia?
Anaemia in the preoperative setting

- Frequency of preoperative anaemia
  - one third to one half of surgical patients
- Common occurrence and associated with
  - increased need for blood transfusion in the perioperative period
  - linked to increased morbidity and mortality in surgical patients
- Higher Hb concentrations are associated with better early functional recovery
- Preoperative anaemia influences the patient’s ability to recover fully and participate in postoperative rehabilitation
- Preoperative anaemia increases need for blood transfusion

Preoperative iron deficiency increases transfusion requirements and fatigue in cardiac surgery patients: a prospective observational study

PATIENTS: (n-100) without known iron disorder and scheduled for cardiac surgery were prospectively included in this observational study.

MEASUREMENTS: transferrin saturation, ferritin, soluble transferrin receptor and C-reactive protein on the day of surgery. Patient fatigue was assessed before surgery and 1 week afterwards (day 7) score that quotes five distinctive dimensions of fatigue.

RESULTS:

- 37/100 iron deficient: Younger 63 vs. 70 years
- more often female
- Preop iron deficiency was associated with: lower preop Hb levels, higher perioperative transfusion rates first week postop
- Patients with iron deficiency but without anaemia (n = 25) received more packed RBC units than those without iron deficiency or anaemia
- Preoperative iron deficiency was associated with higher score of physical fatigue on day 7

Risk Associated With Preoperative Anemia in Cardiac Surgery
A Multicenter Cohort Study

Keyvan Karkouri, MD; Duminda N. Wijeysundera, MD; W. Scott Beattie, MD; for the Reducing Bleeding in Cardiac Surgery (RBC) Investigators

Background—Preoperative anemia is an important risk factor for perioperative red blood cell transfusions, which are associated with postoperative morbidity and mortality. Whether preoperative anemia also is an independent risk factor for adverse outcomes after cardiac surgery, however, has not been fully elucidated.

Methods and Results—In this multicenter cohort study, data were collected on 3500 consecutive patients who underwent cardiac surgery during 2004 at 7 academic hospitals. The prevalence of preoperative anemia, defined as hemoglobin <12.5 g/dL, and its unadjusted and adjusted relationships with the composite outcome of in-hospital death, stroke, or acute kidney injury were obtained. The overall prevalence of preoperative anemia was 26%, with values ranging from 22% to 30% at the participating hospitals. After the exclusion of patients who had severe preoperative anemia (hemoglobin <9.5 g/dL) or preoperative kidney failure and those who underwent emergency surgery, the composite outcome was observed in 7.5% of patients (247 of 3286). The unadjusted odds ratio for the composite outcome in anemic versus nonanemic patients was 3.6 (95% confidence interval, 2.7 to 4.7). The risk-adjusted odds ratios, obtained by multivariable logistic regression and propensity-score matching to control for important confounders (including comorbidities, institution, surgical factors, and blood transfusion), were 2.0 (95% confidence interval, 1.4 to 2.8) and 1.8 (95% confidence interval, 1.2 to 2.7), respectively.

Conclusions—Preoperative anemia is independently associated with adverse outcomes after cardiac surgery. Future studies should determine whether therapies aimed at treating preoperative anemia would improve the outcomes of patients undergoing cardiac surgery. (Circulation. 2008;117:478-484.)
CONCLUSIONS: Preoperative anaemia is independently associated with adverse outcomes after cardiac surgery. Future studies should determine whether therapies aimed at treating preoperative anaemia would improve the outcomes of patients undergoing cardiac surgery.

Risk associated with preoperative anemia in non-cardiac surgery: a single-center cohort study

METHODS: 7,759 consecutive noncardiac surgical patients

RESULTS: Preoperative anemia (39.5% for men and 39.9% for women) and was associated with a nearly five-fold increase in the odds of postoperative mortality.

CONCLUSIONS: Anemia common condition in surgical patients and independently associated with increased mortality and increases the need for transfusion.

Preoperative anaemia and postoperative outcomes in non-cardiac surgery

- ACS NISQIP Database study: 227,425 subjects, >18 years; major non-cardiac surgery, excluding trauma
- 30% of patients were anaemic
- Patients with even mild anemia (Hb 100 - 120g/L in women; 100 - 130 g/L in men experienced:
  - Higher 30 day adjusted mortality
  - Increased morbidity including cardiac, respiratory, urinary tract, wound events, sepsis and thromboembolism
  - Perioperative transfusion also associated with increased morbidity and mortality

Reality check:

The blood bank won’t accept donors with a 125 g/L or lower Hb.

Why would you take a patient to surgery with a Hb under 125 g/L?!!
Can we just use oral iron?
Oral iron

- Compliance in how/when to take
- 80% of those prescribed oral iron do not take it properly
  - Empty stomach in-between meals
  - Appropriate elemental iron dosing
- Requires 3-6 months to fill stores and enhance RBC production
- 6 weeks without interference from other agents may raise Hb to adequate levels but will not fill iron storage tank until the end of 12 weeks

**Note:** Oral iron is not recommended for patients taking acid reducing medication OTC or by prescription
Oral iron (cont)

- Oral iron and patients on gastric acid blockers or surgical alteration (gastric bypass)
  - Chewable antacids
  - Gastric acid reducing drugs
- All either suppress gastric acid secretion or acid levels at varying degrees of suppression
  - Gastric ph below 2.5 released soluble iron
  - Gastric ph above 2.5 released negligible amount of iron
  - ph of >4.0 with PPI for at least 5 hours in 67% of patients and a median of 24 hours with a ph over 3.6
Oral iron (cont)

- These cause hypochlorhydria similar to patients with atrophic gastritis, vagotomy, and partial gastrectomy
- All can lead to iron deficiency with or without anemia and B 12 deficiency
- Variance:
  - Each oral iron product has different elemental iron measurement
  - Goal “elemental iron” intake of 150-300 mg daily
Remember

- Erythropoietin production increases when blood loss occurs (↑ erythropoietic = thus ↑ iron demand)
- Elevated hepcidin (present in patients in inflammatory state of recovery) decreases patients’ ability to absorb iron orally in addition to poor absorption of B 12
- RBC production requires iron accessible (in functional stores) due to the immediate need to retic during acute blood loss
- Renal function has limited erythropoietic production during post pump (CPB) recovery time zone
- Thus preoperative RBC optimisation is ideal
Remember

- Epo without iron is wasteful – endogenous or exogenous
- Patients on H2 blockers or PPI’s do not absorb oral iron or B 12
- Post operative Hb nadir occurs 24 hours after the end of any blood loss
- Patients going into surgery iron replete retic faster, immediately postoperatively = thus nadir proportionate to blood loss
- Iron lab values include serum iron – thus preferably should be done fasting (24-48 hours without supplements or iron, and 8 hours without food)
Some items that assist in your preoperative assessment

- Pre-printed order sets and treatment algorithms makes it easier and more efficient to manage patients

- Include most common diagnoses with check boxes to ensure accurate documentation of medical necessity

- Include most common treatment regimens and doses