

A microscopic view of numerous red blood cells, which are biconcave discs, scattered across the frame. The cells are rendered in a teal color against a darker teal background, creating a textured, dotted effect.

Patient Blood Management
Guidelines: Module 2

Perioperative

Quick Reference Guide

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Disclaimer

This document is a general guide to appropriate practice, to be followed subject to the circumstances, clinician's judgement and patient's preferences in each individual case. It is designed to provide information to assist decision making. Recommendations contained herein are based on the best available evidence published up to the dates shown in Appendix D in the module. The relevance and appropriateness of the information and recommendations in this document depend on the individual circumstances. Moreover, the recommendations and guidelines are subject to change over time.

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Patient Blood Management Guidelines:

Module 2 - Perioperative

Development of this module was achieved through clinical input and expertise of representatives from the Colleges and Societies listed below and an independent consumer advocate (see Appendix A in the module).

Australasian College for Emergency Medicine

Australian and New Zealand College of Anaesthetists

Australian and New Zealand Intensive Care Society

Australian and New Zealand Society of Blood Transfusion

Australian Orthopaedic Association

Australian Red Cross Blood Service

College of Intensive Care Medicine of Australia and New Zealand

Haematology Society of Australia and New Zealand

Royal Australian and New Zealand College of Obstetricians and Gynaecologists

Royal Australasian College of Physicians

Royal Australasian College of Surgeons

Royal College of Nursing Australia

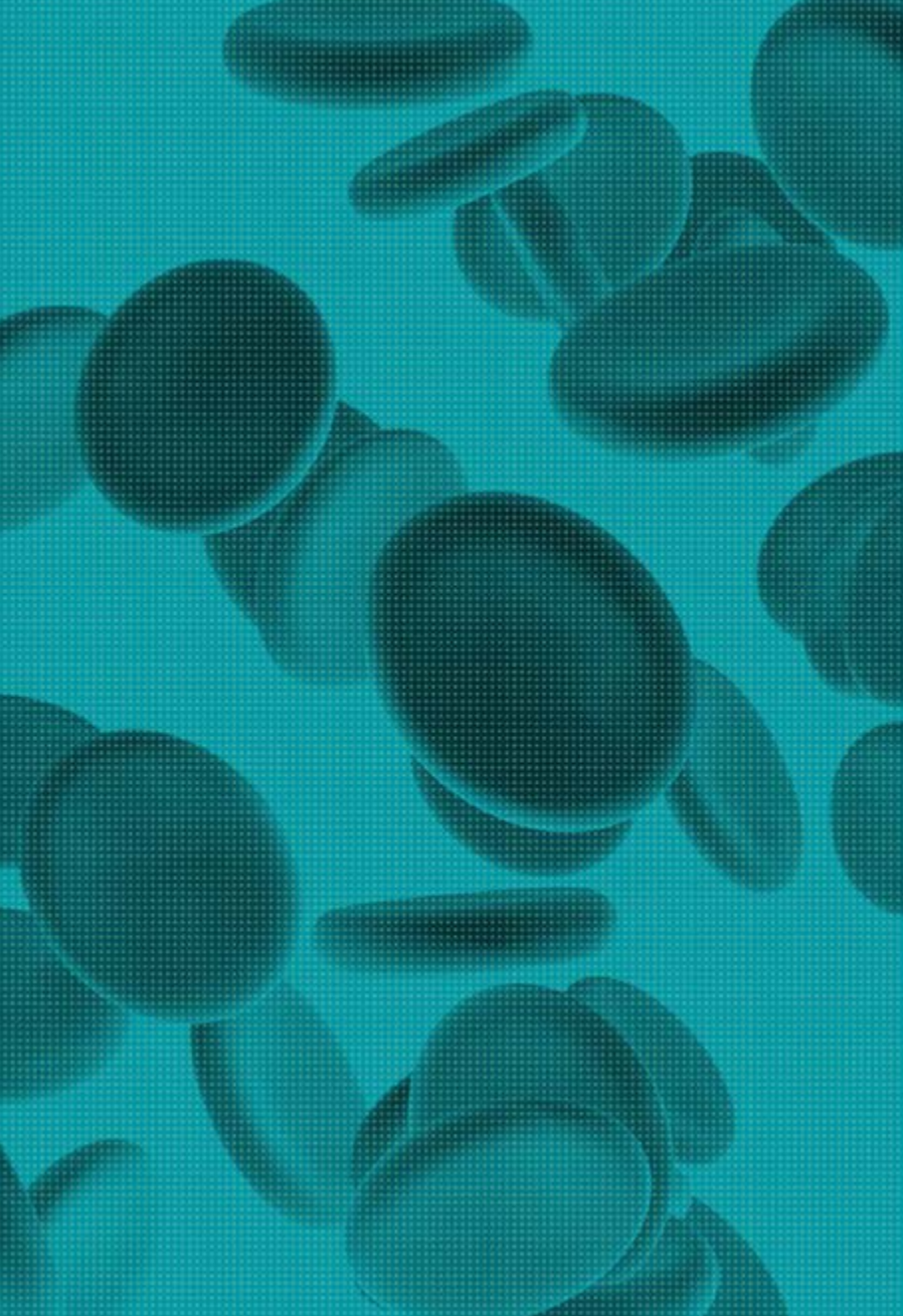
Royal College of Pathologists of Australasia

Thalassaemia Australia

The National Blood Authority gratefully acknowledges these contributions. College and Society endorsement of this Module can be found at <http://www.nba.gov.au>

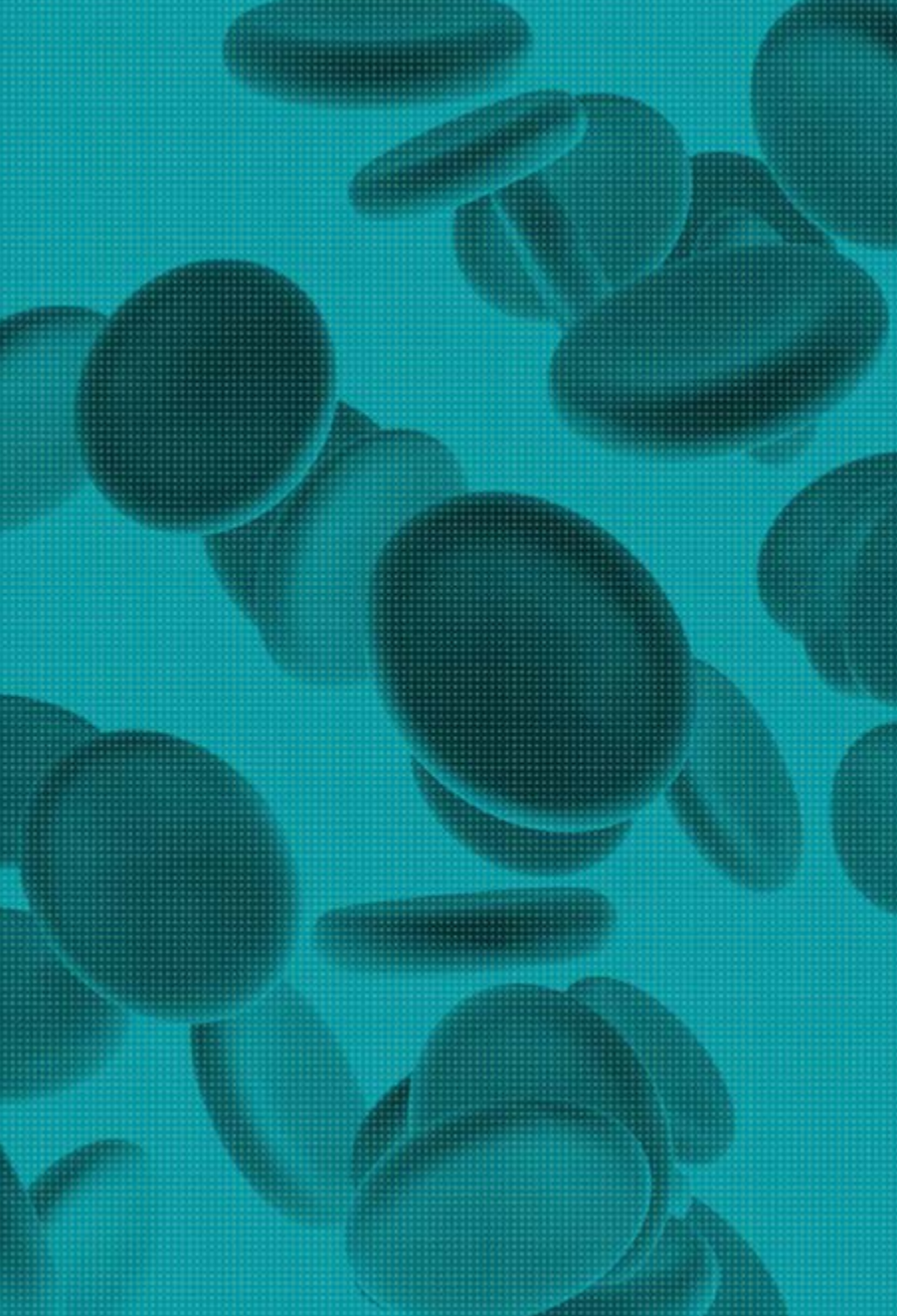


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Abbreviations and acronyms

ANH	acute normovolemic haemodilution
ASBT	Australasian Society of Blood Transfusion
CABG	coronary artery bypass surgery
CPB	cardiopulmonary bypass surgery
CRG	Clinical/Consumer Reference Group
ESA	erythropoiesis-stimulating agent
FFP	fresh frozen plasma
ICU	intensive care unit
INR	international normalised ratio
MAP	mean arterial blood pressure
NBA	National Blood Authority
NHMRC	National Health and Medical Research Council
NSAID	nonsteroidal anti-inflammatory drug
OPCAB	off-pump coronary artery bypass
PAD	preoperative autologous donation
PP	practice point
R	recommendation
RBC	red blood cell
rFVIIa	recombinant activated factor VIIa
TEG	thromboelastography
TGA	Therapeutic Goods Administration



Contents

Abbreviations and acronyms

- 1. Introduction**
- 2. Development of recommendations and practice points**
- 3. Categorisation of recommendations and practice points**
- 4. Recommendations and practice points**
 - 4.1 Patient blood management program
 - 4.2 Anaemia and haemostasis
 - 4.3 Blood conservation strategies
 - 4.4 Appropriate transfusion practices
- 5. Preoperative haemoglobin assessment and optimisation template**
- 6. Blood component product information**
- 7. References**

1. Introduction

The *Patient Blood Management Guidelines: Module 2 – Perioperative* (Module 2 – Perioperative), is the second in a series of six modules that focus on evidence-based patient blood management. The other five modules are critical bleeding/massive transfusion, medical, critical care, obstetrics and paediatrics/neonates. Together, the six modules supersede the 2001 National Health and Medical Research Council/Australasian Society of Blood Transfusion (NHMRC/ASBT) *Clinical Practice Guidelines on the Use of Blood Components*.¹

Module 2 – Perioperative was developed by a Clinical/Consumer Reference Group (CRG) representing specialist colleges, organisations and societies, with the active participation of the clinical community.

This quick reference guide of Module 2 – Perioperative includes:

- a summary of the *recommendations* that were developed by the CRG, based on evidence from a systematic review
- a summary of the *practice points* that were developed by the CRG through consensus decision making
- a preoperative haemoglobin assessment and optimisation template.

Details of the systematic reviews used in the development of Module 2 – Perioperative, for which the search cut-off dates were in mid-2009, are given in the technical reports^{2,3,4,5} available on the National Blood Authority (NBA) website.

2. Development of recommendations and practice points

Recommendations

The CRG developed recommendations where sufficient evidence was available from the systematic review of the literature. The recommendations have been carefully worded to reflect the strength of the body of evidence. Each recommendation has been given a grade, using the following definitions, which were set by the NHMRC:

GRADE A	Body of evidence can be trusted to guide practice
GRADE B	Body of evidence can be trusted to guide practice in most situations
GRADE C	Body of evidence provides some support for recommendation(s) but care should be taken in its application
GRADE D	Body of evidence is weak and recommendations must be applied with caution

Practice Points

The CRG developed practice points where the systematic review found insufficient high-quality data to produce evidence-based recommendations, but the CRG felt that clinicians require guidance to ensure good clinical practice. These points are based on consensus among the members of the committee.

This quick reference guide summarises the recommendations and practice points in a sequence that reflects clinical practice.

3. Categorisation of recommendations and practice points

The following table categorises the recommendations and practice points according to different elements of patient blood management. It also identifies where to find the recommendations and practice points within this quick reference guide and Module 2 – Perioperative, where references are provided.

This section is followed by a series of tables giving the full recommendations and practice points for each element.

ELEMENT OF PATIENT BLOOD MANAGEMENT	RECOMMENDATION	PRACTICE POINT	RELEVANT SECTION OF THIS QUICK REFERENCE GUIDE	RELEVANT SECTION OF MODULE 2 – PERIOPERATIVE
Patient blood management program				
Establishment	R1	PP12–13	4.1	3.1
Implementation	R1	PP12–13	4.1	3.3
Procedural guidelines	R1	PP12–13	4.1	3.6.5, 3.6.6
Anaemia and haemostasis management				
Preoperative anaemia assessment	R2–3	PP1, PP4–5	4.2	3.3, 3.4
Iron and ESA therapy	R4–6	PP6–7	4.2	3.4
Haemostasis management	R7–10	PP8–10	4.2	3.5
Blood conservation strategies				
Preoperative				
Preoperative autologous donation	R11		4.3	3.6.1
Intraoperative				
Surgical haemostasis				3.6
Prevention of hypothermia	R12		4.3	3.6.2

ELEMENT OF PATIENT BLOOD MANAGEMENT	RECOMMENDATION	PRACTICE POINT	RELEVANT SECTION OF THIS QUICK REFERENCE GUIDE	RELEVANT SECTION OF MODULE 2 – PERIOPERATIVE
Appropriate patient positioning		PP11	4.3	3.6.3
Deliberate induced hypotension	R13		4.3	3.6.4
Acute normovolemic haemodilution	R14	PP12	4.3	3.6.5
Intraoperative cell salvage	R15	PP13	4.3	3.6.6
Haemostasis analysis	R16		4.3	3.6.8
Medications	R17–19	PP14–16	4.3	3.6.9
Postoperative				
Postoperative cell salvage	R20		4.3	3.6.10
Appropriate transfusion practices				
Triggers for component transfusion		PP2–3, PP17–18	4.4	3.3, 3.7
Fresh frozen plasma	R21		4.4	3.8
Platelets		PP19	4.4	3.8
Recombinant activated factor VII	R22	PP20	4.4	3.9

4. Recommendations and practice points

4.1 Patient blood management program

RECOMMENDATION – establishment

R1

GRADE C

Health-care services should establish a multidisciplinary, multimodal perioperative patient blood management program (Grade C). This should include preoperative optimisation of red cell mass and coagulation status; minimisation of perioperative blood loss, including meticulous attention to surgical haemostasis; and tolerance of postoperative anaemia.

PRACTICE POINT – implementation

PP1

To implement the above recommendations, a multimodal, multidisciplinary patient blood management program is required. All surgical patients should be evaluated as early as possible to coordinate scheduling of surgery with optimisation of the patient's haemoglobin and iron stores.

PRACTICE POINTS – procedural guidelines

PP12

ANH requires a local procedural guideline that addresses patient selection, vascular access, volume of blood withdrawn, choice of replacement fluid, blood storage and handling, and timing of reinfusion.

PP13

Intraoperative cell salvage requires a local procedural guideline that should include patient selection, use of equipment and reinfusion. All staff operating cell salvage devices should receive appropriate training, to ensure knowledge of the technique and proficiency in using it.

ANH, acute normovolemic haemodilution

4.2 Anaemia and haemostasis management

RECOMMENDATIONS – preoperative anaemia assessment

R2

GRADE C

In patients undergoing cardiac surgery, preoperative anaemia should be identified, evaluated and managed to minimise RBC transfusion, which may be associated with an increased risk of morbidity, mortality, ICU length of stay and hospital length of stay (Grade C).

R3

GRADE C

In patients undergoing noncardiac surgery, preoperative anaemia should be identified, evaluated and managed to minimise RBC transfusion, which may be associated with an increased risk of morbidity, mortality, ICU length of stay and hospital length of stay (Grade C).

PRACTICE POINTS – preoperative anaemia assessment

PP1

To implement the above recommendations, a multimodal, multidisciplinary patient blood management program is required. All surgical patients should be evaluated as early as possible to coordinate scheduling of surgery with optimisation of the patient's haemoglobin and iron stores.

PP4

All surgical patients should be evaluated as early as possible to manage and optimise haemoglobin and iron stores.

PP5

Elective surgery should be scheduled to allow optimisation of patients' haemoglobin and iron stores.

RECOMMENDATIONS – iron and erythropoiesis-stimulating agents

R4

GRADE B

In surgical patients with, or at risk of, iron-deficiency anaemia, preoperative oral iron therapy is recommended (Grade B).

Refer to the preoperative haemoglobin assessment and optimisation template [Section 5] for further information on the optimal dosing strategy.

R5

GRADE A

In patients with preoperative anaemia, where an ESA is indicated, it must be combined with iron therapy (Grade A).

RECOMMENDATION – iron and erythropoiesis-stimulating agent

R6

GRADE B

In patients with postoperative anaemia, early oral iron therapy is not clinically effective; its routine use in this setting is not recommended (Grade B).

PRACTICE POINTS – iron and erythropoiesis-stimulating agents

PP6

Surgical patients with suboptimal iron stores (as defined by a ferritin level $<100 \mu\text{g/L}$) in whom substantial blood loss (blood loss of a volume great enough to induce anaemia that would require therapy) is anticipated, should be treated with preoperative iron therapy.

Refer to the preoperative haemoglobin assessment and optimisation template [Section 5] for further information on the evaluation and management of preoperative patients.

PP7

In patients with preoperative iron-deficiency anaemia or depleted iron stores, treatment should be with iron alone. In patients with anaemia of chronic disease (also known as anaemia of inflammation), ESAs may be indicated.

Refer to the preoperative haemoglobin assessment and optimisation template [Section 5] for further information on the evaluation and management of preoperative patients.

ESA, erythropoiesis-stimulating agent

RECOMMENDATIONS – haemostasis management

R7

GRADE C

In patients undergoing CABG either with or without CPB (OPCAB), clopidogrel therapy should be stopped, where possible, at least 5 days before surgery (Grade C).

R8

GRADE C

In patients undergoing noncardiac surgery, it is reasonable to continue low dose aspirin therapy. This may require specific evaluation in neurosurgery and intraocular surgery (Grade C).

R9

GRADE C

In patients undergoing elective orthopaedic surgery, NSAID therapy should be ceased preoperatively to reduce blood loss and transfusion (Grade C). The timing of the cessation should reflect the agent's pharmacology.

RECOMMENDATIONS – haemostasis management

R10

GRADE B

In patients undergoing minor dental procedures, arthrocentesis, cataract surgery, upper gastrointestinal endoscopy without biopsy or colonoscopy without biopsy, warfarin may be continued (Grade B).

PRACTICE POINTS – haemostasis management

PP8

In patients undergoing cardiac surgery, aspirin may be continued until the time of surgery.

PP9

In patients receiving clopidogrel who are scheduled for elective noncardiac surgery or other invasive procedures, a multidisciplinary approach should be used to decide whether to cease therapy or defer surgery, balancing the risk of bleeding and thrombotic events. Specific evaluation is required for patients who had a recent stroke, or received a drug-eluting stent within the last 12 months or a bare metal stent within the last 6 weeks. If a decision is made to cease therapy preoperatively, this should occur 7–10 days before surgery.

PP10

In patients receiving warfarin who are scheduled for elective noncardiac surgery or other invasive procedures (excluding minor procedures—see Recommendation 10); specific management according to current guidelines is required (e.g. guidelines from the American College of Chest Physicians⁶ and the Australasian Society of Thrombosis and Haemostasis).²

CABG, coronary artery bypass surgery; CPB, cardiopulmonary bypass; NSAID, nonsteroidal anti-inflammatory drug; OPCAB, off-pump coronary artery bypass

4.3 Blood conservation strategies

Preoperative

RECOMMENDATION – preoperative autologous donation

R11

GRADE C

The *routine* use of PAD is not recommended because, although it reduces the risk of allogeneic RBC transfusion, it increases the risk of receiving any RBC transfusion (allogeneic and autologous) (Grade C).

PAD, preoperative autologous donation; RBC, red blood cell

Intraoperative

RECOMMENDATION – prevention of hypothermia

R12

GRADE A

In patients undergoing surgery, measures to prevent hypothermia should be used (Grade A).

PRACTICE POINT – appropriate patient positioning

PP11

Excessive venous pressure at the site of surgery should be avoided by appropriate patient positioning, both during and after the procedure.

RECOMMENDATION – deliberate induced hypotension

R13

GRADE C

In patients undergoing radical prostatectomy or major joint replacement, if substantial blood loss (blood loss of a volume great enough to induce anaemia that would require therapy) is anticipated, deliberate induced hypotension (MAP 50–60 mmHg) should be considered, balancing the risk of blood loss and the preservation of vital organ perfusion (Grade C).

MAP, mean arterial blood pressure

RECOMMENDATION – acute normovolemic haemodilution

R14

GRADE C

In adult patients undergoing surgery in which substantial blood loss (blood loss of a volume great enough to induce anaemia that would require therapy) is anticipated, the use of ANH should be considered (Grade C).

PRACTICE POINT – acute normovolemic haemodilution

PP12

ANH requires a local procedural guideline that addresses patient selection, vascular access, volume of blood withdrawn, choice of replacement fluid, blood storage and handling, and timing of reinfusion.

ANH, acute normovolemic haemodilution

RECOMMENDATION – intraoperative cell salvage

R15

GRADE C

In adult patients undergoing surgery in which substantial blood loss (blood loss of a volume great enough to induce anaemia that would require therapy) is anticipated, intraoperative cell salvage is recommended (Grade C).

PRACTICE POINT – intraoperative cell salvage

PP13

Intraoperative cell salvage requires a local procedural guideline that should include patient selection, use of equipment and reinfusion. All staff operating cell salvage devices should receive appropriate training, to ensure knowledge of the technique and proficiency in using it.

RECOMMENDATION – haemostasis analysis

R16

GRADE C

In adult patients undergoing cardiac surgery, the use of TEG should be considered (Grade C).

TEG, thromboelastography

PRACTICE POINT – medications (aprotinin)

PP14

There is evidence for the beneficial effect of intravenous aprotinin on incidence and volume of transfusion, blood loss, and the risk of reoperation for bleeding. However, the drug has been withdrawn due to concerns that it is less safe than alternative therapies.^a

^a Websites of the Therapeutic Goods Administration (www.tga.gov.au), MedSafe (www.medsafe.govt.nz) and United States Food and Drug Administration (www.fda.gov)

RECOMMENDATIONS – medications (tranexamic acid)

R17

GRADE A

In adult patients undergoing cardiac surgery, the use of intravenous tranexamic acid is recommended (Grade A).

R18

GRADE B

In adult patients undergoing noncardiac surgery, if substantial blood loss (blood loss of a volume great enough to induce anaemia that would require therapy) is anticipated, the use of intravenous tranexamic acid is recommended (Grade B).

RECOMMENDATION – medications (ε-aminocaproic acid)

R19

GRADE C

In adult patients undergoing cardiac surgery, the use of intravenous ε-aminocaproic acid is recommended (Grade C).

PRACTICE POINT – medications (ε-aminocaproic acid)

PP15

There is evidence for the beneficial effect of intravenous ε-aminocaproic acid on reduction of perioperative blood loss and volume of transfusion (Grade C). However, the drug is not marketed in Australia and New Zealand.

PRACTICE POINT – medications (desmopressin)

PP16

In adult patients undergoing surgery in which substantial blood loss (blood loss of a volume great enough to induce anaemia that would require therapy) is anticipated, the *routine* use of desmopressin is not supported, due to uncertainty about the risk of stroke and mortality.

Postoperative

RECOMMENDATION – postoperative cell salvage

R20

GRADE C

In adult patients undergoing cardiac surgery or total knee arthroplasty, in whom significant postoperative blood loss is anticipated, postoperative cell salvage should be considered (Grade C).

4.4 Appropriate transfusion practices

PRACTICE POINTS – triggers for blood component transfusion	
PP2	RBC transfusion should not be dictated by a haemoglobin ‘trigger’ alone, but should be based on assessment of the patient’s clinical status. In the absence of acute myocardial or cerebrovascular ischaemia, postoperative transfusion may be inappropriate for patients with a haemoglobin level of >80 g/L.
PP3	Patients should not receive a transfusion when the haemoglobin level is ≥ 100 g/L. In postoperative patients with acute myocardial or cerebrovascular ischaemia and a haemoglobin level of 70–100 g/L, transfusion of a single unit of RBC, followed by reassessment of clinical efficacy, is appropriate.
PP17	In general, patients with a platelet count $\geq 50 \times 10^9$ /L or an INR ≤ 2 can undergo invasive procedures without any serious bleeding; however, lower platelet counts and higher INRs may be tolerated.
PP18	Specialist guidelines or haematology advice should be sought for at-risk patients undergoing intracranial, intraocular and neuraxial procedures, and for patients with severe thrombocytopenia or coagulopathy.

INR, international normalised ratio; RBC, red blood cell

RECOMMENDATION – fresh frozen plasma	
R21	The prophylactic use of FFP in cardiac surgery is not recommended (Grade B).
GRADE B	

FFP, fresh frozen plasma

PRACTICE POINT – platelets	
PP19	The prophylactic use of platelets after cardiac surgery is not supported.

RECOMMENDATION – recombinant activated factor VII

R22

GRADE C

The prophylactic or routine therapeutic use of rFVIIa is not recommended because concerns remain about its safety profile, particularly in relation to thrombotic adverse events (Grade C).

PRACTICE POINT – recombinant activated factor VII

PP20

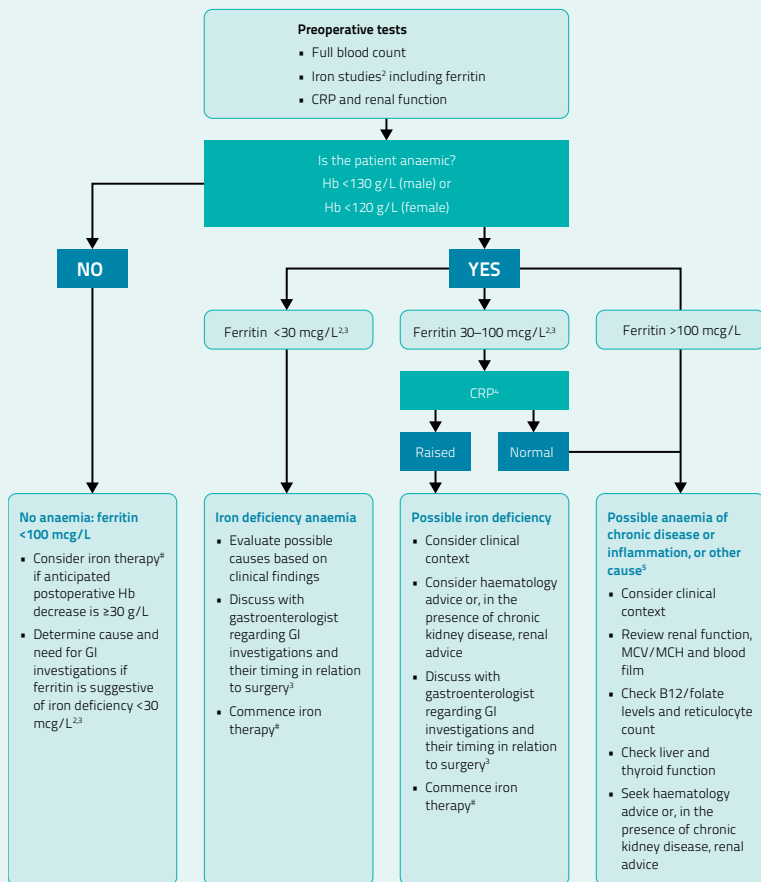
The administration of rFVIIa may be considered in the perioperative patient with life-threatening haemorrhage after conventional measures, including surgical haemostasis, use of antifibrinolytics and appropriate blood component therapy have failed.

rFVIIa, recombinant activated factor VII

Preoperative haemoglobin assessment and optimisation template

This template¹ 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.

An editable electronic copy of this template is available on the National Blood Authority's website (www.nba.gov.au).



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)

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

For more information on the diagnosis, investigation and management of iron deficiency anaemia refer to Pasricha SR, Flecknoe-Brown SC, Allen KJ et al. Diagnosis and management of iron deficiency anaemia: a clinical update. *Med J Aust*, 2010, 193(9):525–532.

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.

6. Blood component production information

Table 1 Blood component product information and dosage – Australia

COMPONENT	CONTENT AND CHARACTERISTICS	VOLUME PER BAG ^a	TYPICAL ADULT DOSE (~ 70 KG)	NUMBER OF BAGS TO PROVIDE TYPICAL DOSE
FFP	<ul style="list-style-type: none"> Plasma recovered from a whole blood donation or apheresis collection Contains all coagulation factors 	250–334 mL	10–15 mL/kg	3–4
Platelets: pooled	<ul style="list-style-type: none"> A pool of platelets derived from the buffy coat of four whole blood donations Leucodepleted 	>160 mL	1 bag	1
Platelets: apheresis	<ul style="list-style-type: none"> A suspension of platelets prepared from a single apheresis donor Leucodepleted 	100–400 mL	1 bag	1
Cryoprecipitate	<ul style="list-style-type: none"> Prepared from a single donated whole blood unit Contains an average of >0.35 g/bag Contains high levels of fibrinogen, factor VIII, von Willebrand factor, factor XIII, fibronectin 	30–40 mL	3–4 g fibrinogen	8–10
Cryoprecipitate: apheresis	<ul style="list-style-type: none"> Prepared from FFP obtained from a plasmapheresis donor Contains an average of >0.8 g/bag 	60 mL (± 10%)	3–4 g fibrinogen	4–5

FFP, fresh frozen plasma

^a Actual volume indicated on label

Table 2 Blood component product information and dosage – New Zealand

COMPONENT	CONTENT AND CHARACTERISTICS	VOLUME PER BAG ^a	TYPICAL ADULT DOSE (~ 70 KG)	NUMBER OF BAGS TO PROVIDE TYPICAL DOSE
FFP	<ul style="list-style-type: none"> Plasma recovered from a whole blood donation or apheresis collection Contains all coagulation factors Leucodepleted 	180–300 mL	10–15 mL/kg	3–4
Platelet: pooled	<ul style="list-style-type: none"> A pool of platelets derived from the buffy coat of four whole blood donations Leucodepleted 	200–350 mL	NA	1
Platelet: apheresis	<ul style="list-style-type: none"> A suspension of platelets prepared from a single apheresis donor Leucodepleted 	180–400 mL	NA	1
Cryoprecipitate	<ul style="list-style-type: none"> Prepared from FFP obtained from a plasmapheresis donor with a fibrinogen level >2.4 g/L Contains an average of 1.4 g/bag Contains high levels of factor VIII, von Willebrand factor, factor XIII, fibronectin Leucodepleted 	80–120 mL	3–4 g	2–3

FFP, fresh frozen plasma; NA, not applicable

^a Actual volume indicated on label

References

- 1 National Health and Medical Research Council (NHMRC) and Australasian Society of Blood Transfusion (ASBT) (2001). *Clinical practice guidelines on the use of blood components*, NHMRC, Canberra, Australia
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