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The Patient Blood Management Concept[1]*

Joint recommendation of the German Society of Anaesthesiology and Intensive Care Medicine and the German Society of Surgery

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Summary

Patient blood management is a multimodal concept that aims to detect, prevent and treat anaemia, optimise haemostasis, minimise iatrogenic blood loss, and support a patient-centred decision to provide optimal use of allogeneic blood products. Although the World Health Organization has already recommended Patient Blood Management as a new standard in 2010, many hospitals have not implemented it at all or only in part in clinical practice. The German Society of Anaesthesiology and Intensive Care Medicine and the German Society of Surgery therefore demand that i) all professionals involved in the treatment should implement important aspects of patient blood management considering local conditions, and ii) the structural, administrative and budgetary conditions should be created in the health care system to implement more intensively many of the measures in Germany.

Introduction

More than 16 million surgical interventions are done in Germany every year. An increasing number of major surgical interventions can be observed with a correspondingly high risk of associated perioperative blood losses demanding blood transfusions. In Germany, allogeneic red blood cells (RBC) are nowadays as safe as never before due to a comprehensive blood donor screening and modern blood transfusion diagnostic methods. Still the transfusion of cellular blood preparations means "transplanting blood as a liquid organ". Undesired effects of RBCs include, among others, the allergic, the febrile non-haemolytic and acute haemolytic transfusion reaction and the transfusion-associated pulmonary insufficiency. In addition, mistransfusions can happen and, although extremely seldom despite high security efforts, the transmission of viruses, parasites or prions [1].

In the future, demographic changes including an increase of elderly citizens will lead to a further increase of diseases requiring treatment and an increasing number of patients who require surgery. In turn, the demand of blood increases again, whereas the readiness to donate blood is still limited in Germany [2]. Any use of this valuable resource must be as responsible as possible also for these reasons.

The transfusion of RBCs ranks worldwide among the five most frequent potentially evitable medical actions [3]. For this reason, anaesthesiologists and surgeons will have to meet the special challenges of the diagnostics of a preoperative anaemia, preventable blood losses and preventable transfusions of allogeneic blood products in order to further improve patient safety.

What is patient blood management?

The WHO has officially recommended since 2010 that all member states shall

With essential contributions by:

German Society of Anaesthesiology and Intensive Care Medicine (DGAI):

P. Meybohm, Klinik für Anästhesiologie, Intensivmedizin und Schmerztherapie, Universitätsklinikum Frankfurt

A. Steinbicker, Klinik für Anästhesiologie, operative Intensivmedizin und Schmerztherapie, Universitätsklinikum Münster

K. Zacharowski, Klinik für Anästhesiologie, Intensivmedizin und Schmerztherapie, Universitätsklinikum Frankfurt

German Society of Surgery (DGCH):

T. Schmitz-Rixen, Klinik für Gefäß- und Endovascularchirurgie, Universitätsklinikum Frankfurt

W. Schwenk, Hamburg

Conflict of interest

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Keywords

Patient Blood Management – Anaemia – Bleeding – Transfusion

implement a so-called patient blood management (PBM). This PBM concept places the patient in the centre of treatment, not the blood products or their application. PBM is an interdisciplinary multimodal approach pursuing the optimisation of patient treatment [4] (Tab. 1).

In principle, PBM focuses during the entire hospital course on the

- Prevention and management of anaemia
- Prevention and/or optimisation of coagulopathy
- Application of comprehensive interdisciplinary measures to prevent and/or reduce unnecessary blood losses
- Patient-centred decision-making to ensure the optimal application of allogeneic blood products

The three independent risks

First risk: **anaemia**

Before surgery, about 30% of non-cardiac surgery patients have anaemia with an increased risk of RBC transfusions, complications and postoperative mortality [5,16]. Consequently, the diagnostics and (if medically possible) the therapy of anaemia are important elements of PBM. Since anaemia in many of these patients is based on a treatable iron deficiency, it is fundamentally crucial to identify anaemic patients and/or iron deficient patients at an early stage (2 to 4 weeks before surgery). The preoperative diagnosis and therapy of anaemia should also be proceed even if the time interval before surgery is shorter in order to enable a more rapid haemoglobin increase after surgery, whenever necessary. The AWMF S3 Guideline "Preoperative Anaemia" to be published soon addresses further detailed recommendations [17].

Second risk: **blood loss**

The prevention and minimisation of unnecessary blood losses is essential to counteract the occurrence of hospital-aquired anaemia.

The following objectives should be pursued:

- Reduction of the number of blood withdrawals to the necessary minimum,
- Use of blood sampling tubes with the smallest volume sufficient for the analysis (e.g. use of smaller tube sizes or minimising the filling level of the tubes),
- Avoidance of discarding diluted blood residues in withdrawal syringes by using closed blood sampling systems.

Other important single PBM measures to reduce unnecessary blood losses are:

- Standardised preoperative procedures which define potential coagulation disorders (e.g. questionnaires on coagulation status and history, standard operating procedures for peri-interventional management if anticoagulants and/or platelet aggregation inhibitors are taken),
- Maintenance and/or correction of physiological haemostasis conditions (e.g. body temperature, calcium, pH value),
- Antagonisation of anticoagulant drug actions (if indicated),
- Application of bedside coagulation point-of-care diagnostics (incl. use of haemotherapy algorithms),
- Targeted coagulation management (including the use of coagulation factor concentrates),
- Calculated use of antifibrinolytics or desmopressin (if indicated).

The prudent application of methods capable of minimising blood losses, cell salvage with autologous blood transfusion and the toleration of a controlled hypotension in patients with acute haemorrhages are additional important measures designed to reduce the extent of intraoperative blood loss.

Third risk: **RBC transfusion**

The objective of RBC transfusion is the assurance of a sufficient global oxygen supply and the avoidance of potential complications which might be associated with acute anaemia. However, a transfusion is the last resort in the treatment of anaemia if a causal therapy of the anaemia had not been possible or satisfactory before. The cross-sectional guidelines of the German Medical Association specify the indication criteria for a RBC transfusion and should be put into practice [18]. If a RBC transfusion is indicated in case of patients not actively/acutely bleeding, only a single RBC should be administered. In addition, the indication for transfusion must also take into consideration patient-specific factors (e.g. age, diagnosis, comorbidity), laboratory values (e.g. haemoglobin concentration, platelet count, coagulation tests), the existence of a coagulopathy and defined physiological factors (oxygen supply and haemodynamic status). At this point, it remains unclear whether cardiovascular risk patients, geriatric or oncological patients will benefit more from a higher transfusion trigger than from the one currently recommended. A clinical corridor for making medical discretionary decisions is still needed in this context.

In order to optimise the use of blood products in clinical routine and support the ordering physician in matters of quality control, an IT-assisted ordering system with integrated treatment and decision-making algorithm (e.g. display of laboratory results, warnings) would be advantageous [19].

References

1. Delaney M, Wendel S, Bercovitz RS, Cid J, Cohn C, Dunbar NM, et al: Transfusion reactions: prevention, diagnosis, and treatment. Lancet 2016;388:2825-2836
2. Greinacher A, Weitmann K, Lebsa A, Alpen U, Gloger D, Stangenberg W, et al: A population based longitudinal study on the implications of demographics on future blood supply. Transfusion 2016;56:2986-2994
3. Chossing Wisely (2017) Choosing wisely. http://www.choosingwisely.org/doctor-patient-lists/ (access date: 01-09-2017)
4. Meybohm P, Fischer D, Schnitzbauer A, Zierer A, Schmitz-Rixen T, Bartsch G, et al: Patient blood management: Current state of the literature. Chirurg 2016;87:40-46
5. Musallam KM, Tamim HM, Richards T, Spahn DR, Rosendaal FR, Habbal A, et al: Preoperative anaemia and postoperative outcomes in noncardiac surgery:

Tabelle 1
Overview of studies concerned with patient blood management.

Region	Patients	Measures/Results	Conclusion	Publication
Preoperative anaemia management				
Worldwide (211 centres)	N = 227.245 Elective Surgery (except Heart Surgery)	Preoperative anaemia 30.4%: Risk of 30-day mortality • No anaemia 0.8% • Mild anaemia 3.5% • Moderate/severe anaemia 10.2%	Anaemia prior to elective surgery increases mortality by a factor of 5 to 13	Musallam et al. [5]
West Australia (Adelaide)	N = 72 Visceral Surgery	Iron IV 8d before surgery: • Reduction of transfused patients from 31% to 12% • Reduction of hospital stay from 9d to 6d	Reduction of transfused patients (62%), length of hospital stay (34%)	Froessler et al. [6]
West Australia (Tasmania)	N = 201 High Risk Operations	Iron IV 1d after surgery: • Reduction of transfused patients from 6% to 1% • Reduction of hospital stay from 12 d to 8 d • Reduction of infections from 14% to 2%	Reduction of transfused patients (80%), length of hospital stay (30%), infections (85%)	Khalafallah et al. [7]
Bleeding/prevention of hospital-acquired anaemia				
Germany (Frankfurt)	N = 100 Heart Surgery	Algorithm-controlled coagulation management: • Reduction of transfused patients from 98% to 84% • Reduction of RBC transfusions from 5 to 3 RBCs/ patient • Reduction of complications from 38% to 8% • Reduction of 6-month mortality from 20% to 4%	Reduction of transfusions (40%), complications (80%), mortality (80%)	Weber et al. [8]
Worldwide (47 studies)	N = 4.141 Surgery	Cell salvage: • Reduction of transfused patients by 39% • Reduction of infections by 28% • Reduction of hospital stay by 2.3 d	Reduction of transfused patients (39%), infections (28%), length of hospital stay (-2,3 d)	Meybohm et al. [9]
Transfusion				
USA/Canada (47 centres)	N = 2.016 Hip Fracture	Restrictive (Hb 8 g/dl) vs. liberal (10 g/dl) RBC transfusions: • Reduction of transfused patients from 97% to 41% • No benefit from more RBCs regarding mobilisation potential	Reduction of transfused patients (58%)	Carson et al. [10]
Great Britain (17 centres)	N = 2.003 Heart Surgery	Restrictive (Hb 7.5 g/dl) vs. liberal (9 g/dl) RBC transfusions: • Reduction of transfused patients from 92% to 53% • No survival benefit by more BCs after 30 d (but after 90 d: increase from 2.6 to 4.2%)	Reduction of transfused patients (43%)	Murphy et al. [11]
Multimodal PBM				
Switzerland (Zurich)	N = 8.871 Orthopaedics	Multimodal PBM (focused on preoperative therapy of anaemia): • Reduction of anaemia from 18% to 13% (hip surgery)/ from 16% to 8% (knee surgery) • Reduction of transfused patients from 22% auf 16% (hip surgery)/ from 19% auf 5% (knee surgery) / from 19% to 9% (spine surgery)	Reduction of anaemia (27-50%), transfused patients (28-74%)	Theusinger et al. [12]
USA (Bangor)	N = 2.662 Heart Surgery	Multimodal PBM: • Reduction of transfused patients from 39% auf 21% • Reduction of acute renal failure from 7.6% to 5% • Reduction of hospital stay from 10d to 8d • Cost savings of $3,000/patient	Reduction of transfused patients (47%), renal failure (35%), length of hospital stay (20%), costs (9%)	Gross et al. [13]
Germany (Frankfurt, Bonn, Münster, Kiel)	N = 129.719 Surgery	Multimodal PBM: • Reduction of transfused patients from 17.2% to 15.2% • Reduction of RBC transfusions from 1.2 to 1.0 RBCs per patient • First confirmation of PBM safety	Reduction of transfused patients (13%), transfusions/patient (17%). confirmation of PBM safety	Meybohm et al. [14]
Australia (4 centres)	N = 605.046 Surgery/Internal Medicine	Multimodal PBM: • Reduction of RBC transfusions risk reduction 0.59 (0.58-0.60) • Reduction of preoperative anaemia from 21% to 14% • Reduction of hospital stay incidence ratio 0.85 (0.84-0.87) • Reduction of infections odds ratio 0.79 (0.73-0.86) • Reduction of mortality odds ratio 0.72 (0.67-0.77) • Cost savings of 7-30 million Australian dollars/year	Reduction of transfused patients (41%), preoperative anaemia (33%), length of hospital stay (15%), infections (21%), mortality (28%), costs (41%)	Leahy et al. [15]

RBC red blood cell; **IV** intravenous.

a retrospective cohort study. Lancet 2011;378:1396-1407

6. Froessler B, Palm P, Weber I, Hodyl NA, Singh R, Murphy EM: The Important Role for Intravenous Iron in Perioperative Patient Blood Management in Major Abdominal Surgery: A Randomized Controlled Trial. Ann Surg 2016;264:41-6
7. Khalafallah AA, Yan C, Al-Badri R, Robinson E, Kirkby BE, Ingram E, et al: Intravenous ferric carboxymaltose versus standard care in the management of postoperative anaemia: a prospective, open-label, randomised controlled trial. Lancet Haematol 2016;3:e415-25
8. Weber CF, Gorlinger K, Meininger D, Herrmann E, Bingold T, Moritz A, et al: Point-of-care testing: a prospective, randomized clinical trial of efficacy in coagulopathic cardiac surgery patients. Anesthesiology 2012;117:531-47
9. Meybohm P, Choorapoikayil S, Wessels A, Herrmann E, Zacharowski K, Spahn DR: Washed cell salvage in surgical patients: A review and meta-analysis of prospective randomized trials under PRISMA. Medicine (Baltimore) 2016;95:e4490
10. Carson JL, Terrin ML, Noveck H, Sanders DW, Chaitman BR, Rhoads GG, et al: Liberal or restrictive transfusion in high-risk patients after hip surgery. N Engl J Med 2011;365:2453-62
11. Murphy GJ, Pike K, Rogers CA, Wordsworth S, Stokes EA, Angelini GD, et al: Liberal or restrictive transfusion after cardiac surgery. N Engl J Med 2015;372:997-1008
12. Theusinger OM, Kind SL, Seifert B, Borgeat L, Gerber C, Spahn DR: Patient blood management in orthopaedic surgery: a four-year follow-up of transfusion requirements and blood loss from 2008 to 2011 at the Balgrist University Hospital in Zurich, Switzerland. Blood Transfus 2014;12:195-203
13. Gross I, Seifert B, Hofmann A, Spahn DR. Patient blood management in cardiac surgery results in fewer transfusions and better outcome. Transfusion 2015;55:1075-81
14. Meybohm P, Herrmann E, Steinbicker AU, Wittmann M, Gruenewald M, Fischer D, et al: Patient Blood Management is Associated With a Substantial Reduction of Red Blood Cell Utilization and Safe for Patient's Outcome. A Prospective, Multicenter Cohort Study With a Noninferiority Design. Ann Surg 2016;264:203-11
15. Leahy MF, Hofmann A, Towler S, Trentino KM, Burrows SA, Swain SG, et al: Improved outcomes and reduced costs associated with a health-system-wide patient blood management program: a retrospective observational study in four major adult tertiary-care hospitals. Transfusion 2017;57:1347-58
16. Baron DM, Hochrieser H, Posch M, Metnitz B, Rhodes A, Moreno RP, et al: Preoperative anaemia is associated with poor clinical outcome in non-cardiac surgery patients. Br J Anaesth 2014;113:416-423
17. AWMF (2013) S3-Leitlinie Präoperative Anämie. http://www.awmf.org/leitlinien/detail/anmeldung/1/ll/001-024.html (access date: 01-09-2017)
18. Executive Committee of the German Medical Association, Cross-sectional Guidelines for Therapy with Blood Components and Plasma Derivatives 2014, 4th revised edition
19. Goodnough TL, Baker AS, Shah N: How I use clinical decision support to improve red blood cell utilization. Transfusion 2016;56:2406-2411.

Corresponding author

Prof. Dr. med. Dr. rer. nat. Kai Zacharowski, ML FRCA

Department of Anaesthesiology, Intensive Care Medicine and Pain Therapy, University Hospital Frankfurt
Theodor-Stern-Kai 7
60590 Frankfurt am Main, Germany

Mail: kai.zacharowski@kgu.de