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Programmes for the management of preoperative anaemia: audit in ten European hospitals within the PaBloE (Patient Blood Management in Europe) working group

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Background and objectives Preoperative anaemia is an independent risk factor for a higher morbidity and mortality, a longer hospitalization and increased perioperative transfusion rates. Managing preoperative anaemia is the first of three pillars of Patient Blood Management (PBM), a multidisciplinary concept to improve patient safety. While various studies provide medical information on (successful) anaemia treatment pathways, knowledge of organizational details of diagnosis and management of preoperative anaemia across Europe is scarce.

Materials and methods To gain information on various aspects of preoperative anaemia management including organization, financing, diagnostics and treatment, we conducted a survey (74 questions) in ten hospitals from seven European nations within the PaBloE (Patient Blood Management in Europe) working group covering the year 2016.

Results Organization and activity in the field of preoperative anaemia management were heterogeneous in the participating hospitals. Almost all hospitals had pathways for managing preoperative anaemia in place, however, only two

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nations had national guidelines. In six of the ten participating hospitals, preoperative anaemia management was organized by anaesthetists. Diagnostics and treatment focused on iron deficiency anaemia which, in most hospitals, was corrected with intravenous iron.

Conclusion Implementation and approaches of preoperative anaemia management vary across Europe with a primary focus on treating iron deficiency anaemia. Findings of this survey motivated the hospitals involved to critically evaluate their practice and may also help other hospitals interested in PBM to develop action plans for diagnosis and management of preoperative anaemia.

Key words: iron deficiency, patient blood management, preoperative anaemia management.

Introduction

Patient Blood Management (PBM) is a multidisciplinary concept to improve patient safety by optimizing the patient's blood volume and decreasing perioperative transfusion requirements [1,2]. The concept comprises more than 100 individual measures, which form the three sustaining pillars of PBM: (1) management of preoperative anaemia, (2) minimization of blood loss and (3) the rational use of allogenic blood products [2]. It has been repeatedly demonstrated that the implementation of PBM into clinical routine reduces anaemia and transfusion rates, length of hospital stay, morbidity and mortality [3–8]. Anaemia, defined by the World Health Organization (WHO) as a haemoglobin (Hb) level <12 g/dl in women and <13 g/dl in men [9], is a major predictor for higher perioperative transfusion requirements, prolonged length of stay in hospital and morbidity [10–12]. The preoperative management of anaemia in turn has been demonstrated to increase Hb levels as well as to reduce perioperative transfusion requirements in patients undergoing surgery [13–16]. In fact, implementing pathways to diagnose and treat preoperative anaemia in general as well as to provide iron supplementation to patients suffering from iron deficiency anaemia (IDA) are recommendations provided by the 2018 Frankfurt Consensus Conference on PBM [17].

Surprisingly, the implementation of preoperative anaemia screening and management programmes across Europe is still fragmentary [18–20]. For instance, a study by Bruun *et al.* [18] revealed that only four of seven questioned hospitals had a policy in place that aimed at identifying and treating anaemia before considering transfusion. In addition, identification of patients suffering from preoperative anaemia is not tantamount to a guaranteed treatment, as demonstrated in a study by Van der Linden *et al.* [19] in which the treatment rate of preoperative anaemia ranged between 0% and 41%. Furthermore, a previous survey conducted by the PaBloE working group showed that some clinicians still seem to be unaware of the association between preoperative anaemia and worse patient outcome [21]. What is largely absent from the published literature so far is detailed information on organization, infrastructure, responsibilities and financing of preoperative anaemia management programmes. For instance, do hospitals centralize all tasks by means of anaemia outpatient clinics or are patients evaluated as part of other clinical routines without the need of extra staff or rooms? Which laboratory parameters are analysed to allow diagnosis of the type of anaemia in order to provide the appropriate form of treatment? What are the waiting times between first contact and surgery and are these times spans used for optimizing the patient's Hb level? Are national guidelines in place or do hospitals rely on local ones? Who is responsible for all that?

This information might be valuable for hospitals at the onset of initiating preoperative anaemia management programmes and might thus facilitate the dissemination of PBM. Therefore, we here present data on if, how and to what extent such programmes are implemented in hospitals from various European nations. This study was conducted within the PaBloE working group founded in 2014 by the European Blood Alliance in order to drive good practice in PBM in Europe.

Methods

In an audit with a total of 74 questions, ten hospitals from seven European nations were asked to provide information on their activities in the management of preoperative anaemia during the year 2016 (Table 1). All hospitals are part of the PaBloE working group and reported their interest in the field of preoperative anaemia. The survey was sent via Email in February 2017 to the representatives in charge of preoperative anaemia management at

each participating hospital. The first part of the audit asked for general information and how preoperative anaemia management is organized (n = 38 questions). In the second part, financing of diagnosis, treatment and staff were evaluated (n = 4 questions), while the last part of the survey focused on diagnostic parameters and treatment of anaemia before surgery (n = 32 questions). The complete list of questions is given in the appendix. As no patient-related data were assessed, no ethical approval of associated ethics committees was necessary. Data are expressed as frequency and were analysed according to the number of responses obtained for each question.

Results

The survey was completed by all ten hospitals after two recalls. All participating hospitals were university-related general hospitals. Total number of beds and approximate number of surgical interventions of the participating hospitals are given in Table 1. Activity, implementation and organization of preoperative anaemia management programmes varied widely (Table 2). While seven hospitals had already established an outpatient clinic for the management of anaemia, others were yet in the beginning of initiating programmes.

Organization

Two nations (UK and Italy) had national guidelines for managing preoperative anaemia. In contrast to the UK, the national guidelines in Italy were only mandatory for orthopaedic patients until October 2016 when they were extended to include major elective surgery. Local guidelines were in place in seven of ten hospitals (Table 2). Management was centralized in an outpatient clinic in seven hospitals. In one hospital, anaemia management was part of a more general preoperative assessment centre. Another hospital established an outpatient clinic focusing solely on treatments with intravenous (IV) iron.

In most hospitals (n = 6), responsibility was with the anaesthetists, while in two hospitals a nurse practitioner/anaemia nurse were in charge (Table 2). In one hospital only Jehovah's witnesses were evaluated by an anaesthetist. In two hospitals, the (consultant) haematologist was responsible for preoperative anaemia management.

Financing

In five hospitals, expenses were primarily covered by the department itself, in some with additional support by health insurances. This is contrasted by reports from three hospitals, where financing was provided by the government (Table 3).

Diagnostics and treatment

The number of patients routinely evaluated for preoperative anaemia at the participating hospitals in 2016 varied from 54 to 1047 (Table 4). In most hospitals, Hb levels <12 g/dl for women and <13 g/dl for men were used to diagnose anaemia (Table 4). Most hospitals evaluated the patient´s iron profile in order to diagnose IDA. Six hospitals always included mean corpuscular volume (MCV) and mean corpuscular haemoglobin (MCH). Four hospitals further incorporated the measurement of ferritin and transferrin saturation (TSAT) regularly. Reticulocyte haemoglobin was assessed in eight hospitals. Cut-offs primarily used to screen for iron deficiency anaemia in most hospitals were TSAT <20% and ferritin <100 μg/l. Other causes of anaemia such as folic acid or vitamin B_{12} deficiencies were less frequently screened for. One hospital followed a slightly different approach, in which folic acid and vitamin B_{12} were only assessed in orthopaedic patients in case of Hb <13 g/dl, ferritin >100 μq/l and TSAT >20%. Inflammation markers were evaluated in eight out of ten hospitals.

Nine hospitals reported that guidelines in place advised treatment prior to surgery if IDA is diagnosed. Six hospitals were able to report on actual practice. In general, more people were treated with IV than oral iron supplementation. Treatment was initiated between two weeks before and the day of surgery. Five hospitals additionally reported on the administration of erythropoietin (Table 4).

Waiting times for elective surgery and timing of preoperative assessment

The mean waiting time for elective surgery differed between 0 and 145 days. In one hospital, patients from all departments except orthopaedics and gynaecology were reported to be assessed for preoperative anaemia, whereas in most other hospitals only patients from individual departments were screened. The mean time span between patients being contacted and surgery varied between 0 and 60 days (Table 5).

Discussion

Since 2010 members of the WHO have been urged to promote PBM programmes [22]. Although the risks of preoperative anaemia have been repeatedly demonstrated [10–12], the implementation of programmes to treat

Table 1 General information on participating hospitals and approximate number of surgical interventions per department in 2016

	University Hospital Frankfurt, Frankfurt am Main, Germany	Molinette University Hospital, Torino, Italy	Mater Dei Hospital, Msida, Malta	Central Manchester University Hospitals NHS Foundation Trust, Manchester, UK[d]	Oxford University Hospitals NHS Foundation Trust, Oxford, UK	Radboud University Medical Centre, Nijmegen, The Netherlands	Karolinska University Hospital, Stockholm, Sweden	University Hospital Strasbourg, Strasbourg, France	University Hospital Nantes, Nantes, France	University Hospital Angers, Angers, France
University related	x	x	x	x	x	x	x	x	x	x
General hospital	x	x[a]	x	x	x	x	x	x	x	x
Number of beds in total	1297	1175	1014	1600[c]	1185	1065	1340	2711[b]	1671	1357
Cardiac	1000	1848	N/A	365	1393	1450	1700	1100	1450	841
Gastrointestinal	1600	3023	N/A	1479	8132[e]	500	6100	N/A	2900	N/A
Maxillofacial	1300	330	N/A	200	1758	1100	4600[f]	N/A	2300	N/A
Orthopaedic	300	0	5437	1429	23 489	2100	4700	N/A	4100	N/A
Urology	1500	1532	N/A	796	8132[e]	2400	2400	N/A	2200	N/A
Vascular	700	1143	N/A	271	1157	225	800	1980	1600	N/A
Neurosurgery	3000	591	N/A	N/A	2203	1841	2700	N/A	1600	N/A
Gynaecology	1500	N/A	N/A	1000	4500	1286	3700	N/A	N/A	N/A

Torino: Additionally: solid organ transplant (n = 339) and ear-nose-throat (n = 1020)

X = Yes.

[a]General and specialities hospital.

[b]2338 inpatient beds and 373 outpatient beds (data end of 2015).

[c]Approximate number.

[d]Only elective surgery.

[e]Within general surgery.

[f]ENT included.

Table 2 Guidelines, organization and responsibility of preoperative anaemia management

	Frankfurt	Torino	Msida	Manchester	Oxford	Nijmegen	Stockholm	Strasbourg	Nantes	Angers
National Guideline		x		x	x					
Local Guideline	x	x		x	x	x[a]		x		x
Outpatient Clinic	x	x	[b]	x	x	x			x	x
Additional staff or/and infrastructure	x	x		x						x
Responsibility	Anaesthetist/ Anaemia nurse	Haematologist working in the Transfusion Centre	Anaesthetist/ Foundation year doctor	Transfusion practitioner/ Consultant haematologist	Nurse practitioner	Preoperative anaesthesia clinic in co-operation with the surgical department (nurse practitioners or physician assistant)	Anaesthetist	Anaesthetist[c]	Anaesthetist	Anaesthetist
Involvement of GP	N	N	N	N	N	S	N	N	N	N

GP, General practitioner; N, Never; S, Sometimes; X, Yes.
[a]Not mandatory.
[b]Patients are evaluated in general preoperative assessment clinic.
[c]Only for Jehovah´s witness.

Table 3 Financing of preoperative anaemia management

	Frankfurt	Torino	Msida	Manchester	Oxford	Nijmegen	Stockholm	Strasbourg	Nantes	Angers
Staff	O	G	G	G	A	O	G/O	O	H/O	O
Consumables	O	G	G	G	A	H	G/O	O	H/O	O
Laboratory testing	O	G	G	G	A	H, if in hospital O	O	O	H/O	O/H/P
Medication	H/O	G	P/G	G	A	H	G/P/O	O	H/O	O/H/P

A, anaesthetics and preoperative assessment; G, government; H, health insurance; O, own department; P, patient.

anaemia preoperatively is still scarce, with various studies reporting low screening and treatment rates [19–21]. For instance, less than 25% of the 706 surveyed physicians in a study by Baron *et al*. routinely assess patients for anaemia [20]. Furthermore, a study based on data from 11 hospitals from Europe and Canada showed that even if low Hb levels were diagnosed preoperatively treatment rates remained low [19]. A survey questioning clinicians working at hospitals within the PaBloE working group reported higher screening (90%) and treatment (37%) rates [21]. When asked why they did not routinely treat for anaemia, the most common answer was lack of time and barriers in organization [21]. This follow-up study now presents data from 2016 about organization, infrastructure, responsibilities and financing of preoperative anaemia management programmes in various hospitals from Europe.

Only two out of seven nations had national guidelines for the management of preoperative anaemia. In the UK, the NICE guidelines recommend pre- and postoperative treatment of IDA with oral or intravenous iron supplementation [23]. In Italy, national guidelines were only in use for orthopaedic patients [24] until October 2016 when a new guideline on PBM was issued regarding all major elective surgery [25]. In contrast, almost all surveyed hospitals had local guidelines in place allowing those without national standards to successfully identify and treat patients. Managing preoperative anaemia by a dedicated outpatient clinic is favoured by the surveyed hospitals, likely as it allows centralization of associated tasks. In Frankfurt, the implementation of such an anaemia outpatient clinic resulted in increased preoperative Hb levels and decreased transfusions requirements [14]. While in most surveyed hospitals, the responsibility for running these processes was solely with the anaesthetists or with the haematologist working in the transfusion centre (Manchester, Torino), Nijmegen reported an avant-garde approach of sharing the responsibility between the preoperative anaesthesia clinic and nurse practitioners and physician assistants from the surgical department, thereby likely improving interdisciplinary collaboration. Nijmegen furthermore was the only hospital reporting on the involvement of general practitioners into the management of preoperative anaemia. As this not only helps to reduce work load for clinicians, but also allows for a timelier screening and treatment, it is an approach certainly worth considering.

The selection of diagnostic parameters to be routinely included into preoperative anaemia assessment by most hospitals indicated a focus on IDA. This is not surprising, given that iron deficiency is one of the most common causes for suboptimal Hb levels in the general [26] and the surgical patient population [27,28]. Additionally, IDA is readily treatable via iron supplementation when diagnosed in a timely fashion. Iron supplementation was primarily performed intravenously, likely reasoned by the short time frame between supplementation and surgery and studies showing the effectiveness and safety of IV iron to replenish iron stores in a short time span [29,30]. Five out of ten participating hospitals screened for other causes of anaemia, for example vitamin B_{12} or folic acid deficiency, while actual treatment was reported by three. The small number of hospitals routinely screening for these deficiencies is likely related to the lower prevalence of these conditions in general. Nevertheless, preoperative anaemia management programmes should also include screening for other causes of anaemia besides iron deficiency in an ideal world.

Erythropoietin as part of preoperative anaemia management was reported by five hospitals. The fact that most nations represented in this study allow erythropoietin use only for a limited number of indications (e.g. in Germany erythropoietin is only indicated for use in orthopaedic surgery or as treatment for anaemia of chronic renal failure) might contribute to the small number of treated patients. Additionally, in some nations, it is still discussed, whether erythropoietin is indicated and cost-effective as part of PBM.

Waiting times differed markedly between the hospitals. In part, this is likely to be explained by fundamentally different national healthcare systems. The survey showed no association between waiting time to surgery in a specific department and the likelihood of inclusion into preoperative anaemia management programmes. In some hospitals, patients with a particularly long waiting time for surgery were not included in preoperative

Table 4 Diagnostic and treatment pathways for preoperative anaemia. Number of treated patients in 2016 is given in brackets

	Frankfurt	Torino	Msida	Manchester	Oxford	Nijmegen	Stockholm	Strasbourg	Nantes	Angers
Cut-off value for patients to be diagnosed as anaemic										
Hb [g/dl]women; men	12;13	12;13	12;14	12;13	13;13	12.89;12.89	12;13	12;13	12;13	13;13
Blood parameters included in preoperative anaemia assessment										
MCH	A	A	A	A	A	A	N	N	N	N
MCV	A	A	A	A	A	A	N	S	A	N
TSAT	A	A	N	A	A	S	N	S	S	S
Ferritin	A	A	S	A	A	S	N	S	S	S
Vitamin B_{12}	N	A	S	A	A	S	N	N	N	N
Folic acid	N	A	S	A	A	S	N	N	N	N
Inflammation	A	A	S	A	A	S	ns	A	S	N
Cut-off values of blood parameters primarily used to screen for IDA										
MCV [fl]								<80		
TSAT [%]	<20	<20		<20	<20	<20		<20	<20	<20
Ferritin [µg/l]	<100	[a]	<10	<100	<30	<100		<100	<100	<100[b]
Number of patients evaluated for anaemia										
	340	1047	ns	54	167	ns	ns	ns	ns	ns
Treatment										
IDA	x	x	x	x	x	x		x	x	x
Latest date to treat IDA	Day of surgery	14 days before surgery	ns	24 h before surgery	ns	ns	ns	ns	Day of surgery	ns
IV ironsupplementation	x(120)	x(330)	ns	x(9)	x(60)	ns	ns	ns	x(35)	x(108)
PO ironsupplementation		x(6)	ns	x(0)	x(167)	ns	ns	ns	ns	0
EPO		x(55)				x (0)		x(5)	x(ns)	x(98)
Vitamin B_{12} supplementation		x(4)	ns	x(2)		x(ns)	ns	ns	ns	ns
Folic acid supplementation		x(37)	ns	x(1)		x(ns)	ns	ns	ns	ns

A, always; EPO, erythropoietin; IV, intravenous; N, never; ns, not specified; PO, per os; S, sometimes; X, yes.

[a]Tested, but not considered for IDA.

[b]Or ferritin <300 µg/l and TSAT <20%.

Table 5 Details on (i) mean waiting times (days) for elective surgery superimposed with colour-coded information if patients of respective departments are included into preoperative anaemia management programmes and (ii) mean timing of the patient being contacted for the preoperative assessment

	Frankfurt	Torino	Msida	Manchester	Oxford	Nijmegen	Stockholm	Strasbourg	Nantes	Angers
Mean waiting times for elective surgery (days between contact and surgery)										
Cardiac	0–14	0–30	ns	70	93	19	37	0-60	21	0–21
Gastrointestinal	4–20	0–21	ns	ns	75	32	26	ns	ns	4–20
Maxillofacial	4–20	5–30	ns	71	108	93	38	ns	ns	ns
Orthopaedic	ns	ns	42	145	27	50	97	ns	ns	28
Urology	2–10	5–30	ns	70	83	69	25	ns	ns	15
Vascular	0–7	10–40	ns	28	53	19	12	0–60	ns	ns
Neurosurgery	0	5–30	ns	82	111	49	29	ns	ns	ns
Gynaecology	0	ns	ns	56	116	42	29	ns	ns	ns
When is the patient contacted for preoperative anaemia assessment?										
Mean timing for all participating departments	4–14 days before surgery	5–60 days before surgery	ns	At listing	Mean 21 days before surgery	Depends on department & waiting list	ns	ns	ns	10–28 days before surgery

Green, department always included patients in preoperative anaemia management; Orange, department sometimes included patients in preoperative anaemia management; Red, department never included patients in preoperative anaemia management; Grey, no information if department is included into preoperative anaemia management; ns, not specified.

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management programmes, despite the fact that this time could easily be used to optimize Hb levels in anaemic patients prior to surgery. Furthermore, in some hospitals, waiting time for surgery was much longer than the time interval quoted for contacting for preoperative anaemia assessment within the same hospital. In cases with particularly long waiting times, contacting the patient earlier for preoperative assessment should be considered, as it allows for timelier treatment.

A limitation of this study is the selection of the participating hospitals. With all being part of the PaBloE working group, motivation regarding preoperative anaemia management is likely higher compared to other hospitals. However, there was still a wide variation between the participating hospitals regarding the number of patients being assessed and treated for preoperative anaemia in 2016. Considering the high number of surgical interventions with high expected blood loss performed and the generally high prevalence of anaemia between 20% and 45% [31], the number of patients treated for anaemia seems to be falling short. The small number of patients treated might result from a yet incomplete implementation of preoperative assessment processes in all surgical fields or from an incomplete adherence to such processes by clinicians from different surgical specialities. Another limitation of this is study is the absence of information on the preoperative Hb level. Furthermore, three hospitals had not implemented any outpatient clinic in 2016.

In conclusion, there are large variations regarding organization, financing and state of implementation of preoperative anaemia management in European hospitals. Programmes in most hospitals focus on screening, based on Hb levels, differing sets of iron status parameters, and on treating iron deficiency anaemia with IV iron supplementation. Responsibility was mostly carried by anaesthetists, frequently with additional support through specific outpatient clinics. Management was primarily covered by local guidelines, as only the minority of hospitals could rely on national standards. While the majority of surveyed hospitals at least had some form of preoperative anaemia management in place, there certainly remains a large potential for improvement, for instance with regard to mandatory national/European guidelines on better utilization of waiting times aimed at optimizing the preoperative status of patients. Initiating programmes for preoperative anaemia management is possible on different levels within an organization by different departments and already small steps may help to better patient care. Since implementing new programmes in big hospitals is a lengthy process, observational surveys such as this one may help to awaken the consciousness, both medical and administrative on the challenge of managing preoperative anaemia, initiating a positive trend.

Author contribution

MJK, CF and PM developed a first draft of the manuscript. All authors contributed to improve this draft. All authors read and approved the final manuscript.

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Conflict of interests

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