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Preoperative anaemia in elective surgery with bleeding risk

ORIGINAL ARTICLE

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Background and aim
Anaemia is associated with increased morbidity and mortality in surgical patients, but it is often a modifiable condition. International studies have reported a high prevalence of preoperative anaemia (30–40 %), particularly due to iron deficiency. This article aims to describe the prevalence of preoperative anaemia in a Norwegian surgical patient population, which includes urological, gynaecological, orthopaedic and gastrointestinal patients.

Material and method
Adult patients undergoing elective surgery with a risk of > 500 mL blood loss at Bærum Hospital between 1 January and 30 June 2024 were included. Demographic and perioperative data were collected retrospectively and included surgical category, haemoglobin concentration, ferritin measurement, red blood cell transfusion and iron supplementation.

Results
A total of 293 patients were included in the study. Preoperative anaemia (haemoglobin level < 13 g/dL) was identified in 99/293 patients (34 %). Ferritin was measured in 25/99 patients (25 %) with preoperative anaemia. Preoperative iron supplementation was administered to 27/99 patients (27 %) with anaemia. Overall, 29/293 patients (10 %) received red blood cell transfusions during the perioperative period.

Interpretation
The prevalence of preoperative anaemia in this surgical population is comparable to that reported in larger European studies. Ferritin measurement is part of the diagnostic evaluation and treatment stratification of anaemia. The low rate of preoperative ferritin testing suggests a potential for improvement in the preoperative optimisation of haemoglobin levels.

Main findings

Ninety-nine of 293 patients (34 %) scheduled for elective surgery with bleeding risk had preoperative anaemia, defined as a haemoglobin level below 13 g/dL.

Ferritin was measured in 25 of the 99 patients with preoperative anaemia.

Anaemia is independently associated with increased morbidity and mortality in surgical patients (1–3). Several international studies of surgical populations have reported an anaemia prevalence of 30–40 % (1–4), with iron deficiency being the most common cause (4–6). In moderate to major surgical procedures, even mild preoperative anaemia is associated with increased transfusion requirements, a higher risk of postoperative infection, prolonged length of stay and readmission (1–3, 7).

The World Health Organization (WHO) defines anaemia as a haemoglobin (Hb) level < 12 g/dL in women and < 13 g/dL in men (8). Women have lower circulating blood volume, lower haemoglobin concentration and a higher prevalence of iron deficiency than men, and several international guidelines therefore recommend using a haemoglobin level < 13 g/dL as a common threshold for both women and men when screening for preoperative anaemia (6, 9, 10). Haemoglobin levels below 13 g/dL have been associated with an increased incidence of postoperative complications, irrespective of sex (11, 12). Perioperative observational studies have shown that women with haemoglobin levels of 12–12.9 g/dL have a significantly higher likelihood of receiving red blood cell transfusions and of developing complications such as pneumonia, sepsis and acute kidney injury compared with women with haemoglobin levels ≥ 13 g/dL (7, 12).

In 2024, the WHO published a guideline (13) emphasising that all Member States should establish guidelines to optimise and conserve patients' own blood. Although red blood cell transfusion can be life-saving, it is associated with an increased risk of postoperative complications (14, 15). Key perioperative measures include identifying and treating anaemia before surgery with a risk of bleeding, minimising surgical blood loss and avoiding unnecessary transfusions. Implementation of such measures has demonstrated benefits for patients and the health service, including a reduced need for red blood cell transfusions, a lower incidence of postoperative complications, shorter length of stay and reduced mortality (16).

The aim of this study was to assess the prevalence of preoperative anaemia in elective surgery with a risk of blood loss > 500 mL in a general Norwegian surgical population. We also examined the use of treatment interventions such as red blood cell transfusion and iron therapy.

Material and method

The study was a collaborative project between the Department of Surgery and the Department of Anaesthesia, Intensive Care and Surgery at Bærum Hospital, Vestre Viken. The project was approved by the data protection officer at Vestre Viken (24/10307–3) as an internal quality register, in accordance with section 6 of the Patient Records Act. No interventions were performed in the patient cohort, and no measurements were conducted beyond standard clinical practice. All blood tests and registrations were carried out according to the hospital's procedures at the time, and data were collected retrospectively. All data were handled in accordance with confidentiality regulations, pursuant to section 26 of the Health Personnel Act.

An overview was established of elective surgical procedures at Bærum Hospital that were considered to carry a risk of blood loss > 500 mL (Box 1). The list was compiled in collaboration with local surgeons and approved by the lead senior consultant for each surgical category. The overview was subjective and not based on validated assessments. The list resembles comparable international classifications (10, 17). Patients aged over 18 years who underwent elective surgery with an estimated blood loss > 500 mL during the period 1 January 2024 to 30 June 2024 were included.

Box 1 Elective surgical procedures considered to carry a risk of blood loss > 500 ml

Orthopaedics

Revision knee arthroplasty or hip arthroplasty

Bilateral total knee arthroplasty

Femoral amputation

Spinal fusion with instrumentation

Gynaecology

Myomectomy

Laparoscopic hysterectomy

Open hysterectomy

Laparotomy (salpingo-oophorectomy, large cysts)

Gastrointestinal surgery

Total colectomy

Hemicolectomy

Sigmoid resection

Rectal resection

Urology

Percutaneous nephrolithotomy

Percutaneous pyelolithotomy with lithotripsy

Percutaneous nephroscopy

Transurethral resection of the prostate
Transurethral resection of the bladder

Demographic and perioperative data obtained from the hospital's electronic medical record system (DIPS) included age, sex, presence of cancer, anticoagulant therapy (antiplatelet agents and/or anticoagulants), ASA classification, laboratory results (haemoglobin, ferritin, pretransfusion testing), surgical category, red blood cell transfusion and iron therapy. The ASA classification (18) is the American Society of Anesthesiologists' grading of a patient's functional status and perioperative risk. For example, a patient classified as ASA I is completely healthy, whereas a patient with ASA IV is severely ill and anaesthesia will entail a high risk.

Red blood cell transfusion was recorded if administered during the perioperative hospital stay and/or within one month prior to surgery. Iron therapy included oral and/or intravenous treatment administered less than two months before surgery, either in primary care or the specialist health service. Haemoglobin and ferritin measurements were recorded if performed in the specialist health service within three months preoperatively. Pretransfusion testing included ABO blood group typing and screening for irregular red blood cell antibodies and was recorded as a categorical variable (performed: yes/no). Ferritin was selected as an indicator of whether anaemia and iron status had been investigated and was recorded as a categorical variable (ferritin measured: yes/no), without recording the actual ferritin value.

A haemoglobin level < 13 g/dL was used as a common threshold for preoperative anaemia in both women and men (6, 9, 10). The severity of anaemia was defined as follows: 'mild' at haemoglobin levels of 11.0–12.9 g/dL; 'moderate' at haemoglobin levels of 8.0–10.9 g/dL; and 'severe' at haemoglobin levels < 8.0 g/dL (8).

Data were stored and analysed using the registry tool Ledidi (Ledidi AS, Oslo, Norway). Categorical data are presented as numbers and percentages of individuals in each category. Continuous data are presented as median values with interquartile ranges.

Results

A total of 863 elective surgical procedures were performed at the Central Operating Unit at Bærum Hospital during the period 1 January 2024 to 30 June 2024. Of these, 330 patients were included based on the criterion of 'elective surgery with a risk of blood loss > 500 mL'. Seven patients were excluded after a review of medical records due to a subacute urgency classification. Thirty pregnant patients were excluded because a different definition of anaemia applies in pregnancy (anaemia defined as haemoglobin level < 11 g/dL). The final study population consisted of 293 adult patients (Figure 1). The median age was 68 years (interquartile range 55–77), and 137 patients (47 %) were women.

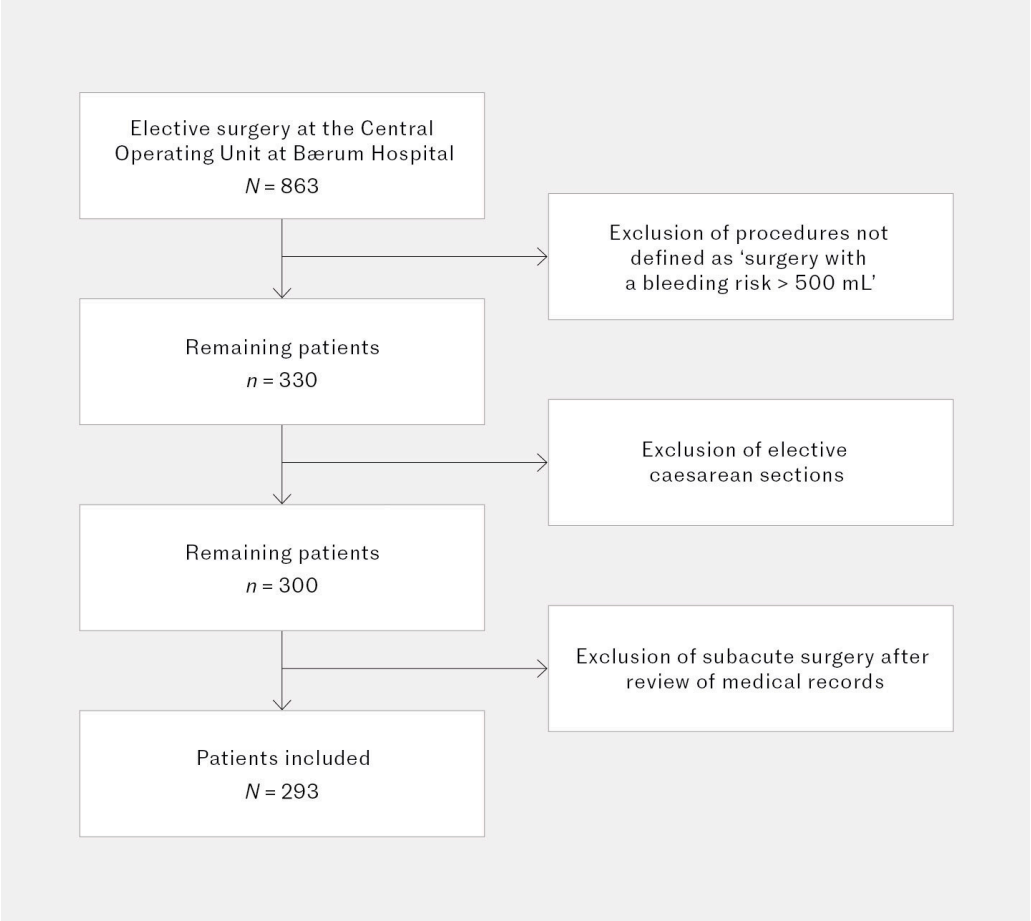

Figure 1 Flow chart showing the inclusion of patients aged over 18 years who underwent elective surgery with a risk of blood loss > 500 mL at Bærum Hospital during the period 1 January 2024 to 30 June 2024. Thirty pregnant patients were excluded because a different definition of anaemia applies in pregnancy (anaemia defined as a haemoglobin level < 11 g/dL).

A total of 112 patients (38 %) underwent urological surgery, 97 (33 %) gastrointestinal surgery, 59 (20 %) gynaecological surgery and 25 (9 %) orthopaedic surgery. Patient characteristics and the prevalence of preoperative anaemia varied between surgical categories (Table 1). Overall, 99 patients (34 %) had preoperative anaemia, of whom 78 (79 %) had mild, 20 (20 %) moderate and 1 (1 %) severe anaemia. Among women, 60/137 (44 %) had preoperative anaemia, and haemoglobin was not measured preoperatively in 6 women (4 %). Among men, 39/156 (25 %) had preoperative anaemia, and haemoglobin was not measured preoperatively in 28 men (18 %), all from the urological patient group. Pretransfusion testing was performed preoperatively in 282 patients (96 %).

A total of 29 patients (16 men and 13 women) with a median age of 79 years (73–82) received red blood cell transfusions, with a median of 2 (2–4) units transfused. Transfusions were administered preoperatively (n = 13), intraoperatively (n = 9) and postoperatively (n = 15). The median haemoglobin level prior to transfusion was 8.1 (7.2–9.2) g/dL.

Serum ferritin levels were measured in 49/293 (17 %) patients overall and in 25/99 (25 %) of patients with preoperative anaemia. Of these 25 patients, 21 underwent gastrointestinal surgery, 1 gynaecological surgery, 2 orthopaedic surgery and 1 urological surgery.

A total of 36/293 (12 %) patients received preoperative iron therapy (Table 1). Nineteen patients received iron intravenously, all of whom were patients with colorectal cancer from the gastrointestinal surgery group. Among patients with preoperative anaemia, 27/99 (27 %) received iron prior to surgery, either orally initiated in primary care (10 women and 1 man) and/or intravenously (16 gastrointestinal surgery patients, equally distributed between the sexes).

Discussion

Preoperative anaemia was identified in 34 % of patients scheduled for elective surgery with an estimated risk of blood loss exceeding 500 mL. Our findings were consistent with the reported prevalence of preoperative anaemia in large-scale European studies. An Austrian study reported a prevalence of 33 % in a mixed surgical population including 6908 patients (3), while a Spanish multicentre study involving 3342 patients reported a prevalence of 36 % (4).

The aetiology of anaemia is often multifactorial and may reflect underlying serious disease rather than an isolated, modifiable risk factor. Iron deficiency, however, is the most common cause of anaemia in the surgical population and is particularly relevant prior to planned surgery where there is a risk of significant bleeding and additional iron loss (4, 5). Although bleeding, and thus iron deficiency anaemia, may be prevalent among patients with various pathologies scheduled for surgery (such as uterine fibroids, bladder cancer and colorectal cancer), measurement of ferritin and administration of intravenous iron were only standardised in the colorectal cancer group in our population (a subgroup of the gastrointestinal surgery group). Ferritin is often included in an 'anaemia blood test panel', which typically also comprises several iron parameters as well as vitamin B12 and folate levels. In the specialist health service, ferritin was measured in a total of 17 % of patients. Ferritin may have been measured in primary care prior to referral for surgery; nevertheless, assessment of preoperative iron stores is clinically relevant. Measurement of ferritin is recommended in international guidelines for preoperative anaemia, both for diagnostic purposes and to stratify patients who may benefit from iron therapy (6, 10, 19). For each millilitre of blood lost, approximately 0.5 mg of iron is lost, and iron is required for efficient production of new blood cells following surgery (20).

The surgical procedures we included carry a moderate risk of bleeding, unlike high-risk procedures such as vascular or thoracic surgery, which are performed at larger hospitals (10, 17). Unfortunately, we do not have data on the actual blood loss in our cohort. In our view, there is a lack of national, validated overviews defining 'surgery with bleeding risk'. In our internal quality registry, 96 % of patients had pre-transfusion blood tests, in line with the Norwegian version of the Choosing Wisely initiative *(Gjør Kloke Valg),* which states that 'preoperative transfusion testing should only be ordered for operations where blood transfusions are often indicated' (21). However, haemoglobin was not measured preoperatively in 29 % of urological patients; the urology department will therefore review its procedures for preoperative testing.

Overall, 29/293 (10 %) patients received red blood cell transfusions, with a median haemoglobin level prior to transfusion of 8.1 g/dL, reflecting good adherence to restrictive transfusion thresholds. In practice, however, restrictive transfusion thresholds appear to have resulted in an 'untreated anaemic interval', in which patients not receiving transfusions are often not offered alternative treatment. According to international guidelines, patients with severe, moderate or mild anaemia should be offered treatment that optimises their own blood, regardless of transfusion indication (13, 19).

International guidelines provide specific recommendations on how to manage anaemia in the perioperative period (9, 10, 19), but there are no equivalent Norwegian guidelines. The Norwegian Society for Immunology and Transfusion Medicine notes in Choosing Wisely *(Gjør kloke valg)* that transfusion should be 'avoided as a treatment for iron deficiency anaemia' (22). Haemoglobin levels should, for example, be checked at the time of referral for surgery. If iron deficiency anaemia is identified, treatment should be initiated in primary care, and the sooner, the better. This includes supplementation with vitamin B12, folate or iron.

In most patients with iron deficiency anaemia, oral iron therapy can initially be attempted, provided the anaemia is mild (haemoglobin > 11 g/dL) and there is sufficient time (months) before the planned surgical procedure. If the patient does not achieve an adequate increase in iron stores and haemoglobin, or if surgery that should not be postponed is only weeks away, intravenous high-dose iron therapy should be considered (19). Patients with chronic inflammation will also yield less benefit from oral supplementation due to reduced iron absorption, and erythropoietin therapy is recommended for a small subgroup of patients.

Limitations of the study were the retrospective collection of data from a local hospital, the inclusion of only 293 patients over a six-month period, and the small number of patients in each surgical category. We did not examine precise ferritin levels or other laboratory measurements used in anaemia evaluation. Ferritin and haemoglobin levels may also have been measured for reasons other than preoperative assessment, as we included laboratory results up to three months before surgery. The list of surgical procedures expected to involve blood loss > 500 mL was not based on validated assessments, and we lacked data on both the actual intraoperative blood loss and postoperative haemoglobin levels. We did not investigate complications associated with preoperative anaemia; however, a number of studies have reported on this (1–3).

Conclusion

Preoperative anaemia was found in 34 % of patients scheduled for elective surgery with a risk of bleeding. The prevalence at this local hospital is similar to that reported in mixed surgical populations in Europe, and there are European guidelines that specifically address the management of preoperative anaemia. We believe our findings underscore the need for corresponding Norwegian guidelines.

The article has been peer-reviewed.

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