



Original research

Correction of iron-deficiency anaemia in colorectal surgery reduces perioperative transfusion rates: A before and after study

Edel M. Quinn ^{a,*}, Ellen Meland ^b, Stacy McGinn ^a, John H. Anderson ^a^a Department of Colorectal Surgery, Queen Elizabeth Building, Glasgow Royal Infirmary, G4 0ET, Glasgow, Scotland, UK^b Pharmacy Department, Glasgow Royal Infirmary, G4 0SF, Glasgow, Scotland, UK

HIGHLIGHTS

- Anaemia is associated with poorer perioperative outcomes.
- Iron-deficiency can be corrected relatively quickly using intravenous iron.
- Preoperative anaemia correction results in reduced perioperative blood transfusion.
- Anaemia correction is also associated with shorter lengths of hospital stay.

ARTICLE INFO

Article history:

Received 19 September 2016

Received in revised form

6 November 2016

Accepted 10 December 2016

Available online 21 December 2016

Keywords:

Anaemia
 Iron-deficiency
 Intravenous iron
 Colorectal cancer
 Surgery

ABSTRACT

Background: Preoperative anaemia is a risk factor for poorer postoperative outcomes and many colorectal cancer patients have iron-deficiency anaemia. The aim of this study was to assess if a preoperative iron-deficiency anaemia management protocol for elective colorectal surgery patients helps improve detection and treatment of iron-deficiency, and improve patient outcomes.

Materials and methods: Retrospective data was collected from 95 consecutive patients undergoing colorectal cancer surgery to establish baseline anaemia correction rates and perioperative transfusion rates. A new pathway for early detection of iron-deficiency anaemia, and treatment with intravenous iron replacement, for colorectal cancer patients was then developed and implemented. Data from 81 patients was collected prospectively post-implementation to assess the impact of the pathway.

Results: Pre-intervention data showed anaemic patients were seventeen times more likely to require perioperative transfusion than non-anaemic patients (95% CI 1.9–151.0, $p = 0.011$). Post-intervention, fifteen patients with iron-deficiency were treated with either intravenous ($n = 8$) or oral iron ($n = 7$). Mean Day 3 postoperative haemoglobin levels were significantly lower in patients with uncorrected anaemia (9.5 g/dL, $p = 0.004$); those patients whose anaemia was corrected by iron replacement therapy preoperatively had similar postoperative results to non-anaemic patients (10.93 g/dL vs 11.4 g/dL, $p = 0.781$). Postoperative transfusion rates remained high at 38% in patients with uncorrected anaemia, compared to 0% in corrected anaemia and 3.5% in non-anaemic patients.

Conclusions: Introduction of an iron-deficiency anaemia management pathway has resulted in improved perioperative haemoglobin levels, with a reduction in perioperative transfusion, in elective colorectal patients. Implementation of this pathway could result in similar outcomes across other categories of surgical patients.

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1. Introduction

1.1. Problem description

Preoperative anaemia is common in colorectal cancer patients [1]. Whilst anaemia correction preoperatively is recommended [2], the means and timing of treatment is usually dependent on local

* Corresponding author.

E-mail address: edelquinn@rcsi.ie (E.M. Quinn).

policy and often at the discretion of individual clinicians.

1.2. Available knowledge

Preoperative anaemia is a risk factor for poorer postoperative outcomes [3,4]. Studies have shown that preoperative anaemia exists in approximately one-third of patients undergoing non-cardiac surgery [5,6] and can affect more than half of those with tumours of the right colon [1]. Patients with preoperative anaemia are more likely to require perioperative blood transfusion, and transfusion is additionally associated with increased perioperative morbidity [3,7].

The most effective strategy to avoid perioperative anaemia and transfusion requirements is to identify and correct preoperative anaemia whenever possible [8]. Haemoglobin (Hb) and iron status should be assessed prior to any major surgery [2] and if iron-deficiency anaemia (IDA) is detected, treatment should be instituted as soon as possible. Whenever there is enough time, oral iron supplementation can be attempted [2] but an intravenous (IV) iron course is suggested in instances where a quicker response is needed [9].

One of the difficulties in treating cancer patients is the requirement to ensure their surgery takes place within recommended timeframes [10]. Use of IV iron allows treatment to take place closer to the time of surgery but still requires that early diagnosis of IDA is made. Thus, identifying IDA as soon as possible in the patient journey is critical. To our knowledge, this is the first report of implementation outcomes of a complete diagnosis and management pathway for IDA in colorectal cancer patients.

1.3. Aim of the study

Our aim was to assess if implementation of a preoperative iron-deficiency anaemia management protocol for elective colorectal surgery patients, incorporating detection of iron-deficiency anaemia in a timely fashion and treatment via intravenous iron, reduces the rate of perioperative anaemia, and assess the effect of this process on patient outcomes, including length of hospital stay.

2. Materials and methods

As a quality improvement project, this study was designed and reported in line with the SQUIRE 2.0 guidelines [11].

2.1. Context

The project was performed in the Colorectal Unit of a large tertiary referral centre. Baseline data was retrospectively collected, using a prospectively maintained database, from 95 consecutive patients undergoing colorectal cancer resection in the year 2015, to establish baseline preoperative anaemia levels in this cohort, perioperative blood transfusion rates and patient outcomes. Nineteen patients were excluded (six endoscopic/local rectal procedures, 13 emergency procedures) and a total of 76 patients were included in this final analysis.

2.2. Intervention

Using the data gathered, a standardised pathway focusing on early detection of preoperative iron-deficiency anaemia and incorporating an evidence-based preoperative anaemia management protocol, appropriate to our unit's current operating practices was developed. The protocol (Fig. 1) required all patients diagnosed with colorectal cancer to have a haemoglobin, ferritin and C-reactive protein (CRP) level checked in the endoscopy unit after initial

diagnosis at colonoscopy. This timepoint was chosen to allow anaemia to be identified in a timely manner, thus enabling treatment to be commenced at least ten days preoperatively. Those patients scheduled for surgical resection, found to be anaemic and iron-deficient, were then selected for intravenous iron replacement prior to surgery. A cut-off value of 11 g/dL was chosen for intervention in an attempt to achieve maximum benefit from intervention. Although anaemia is defined as <12 g/dL in females and <13 g/dL in males [12], no patient in our pre-intervention cohort with a Hb of 11–13 g/dL required perioperative transfusion.

New referrals to the Colorectal Cancer multidisciplinary team (MDT) are made via two specialist colorectal nurses, who reviewed these blood results at the time of referral. Any patients identified with IDA had attendance arranged at the surgical day ward for IV iron, which was prescribed according to patient weight and baseline Hb by our unit pharmacist.

2.3. Outcome measures and analysis

From January to June 2016, data was prospectively gathered on all new patients referred to the Colorectal Cancer MDT. Data was collected on patients' pre- and postoperative Hb levels, iron-deficiency rates, methods and success of iron-deficiency correction, perioperative transfusion rates, postoperative complications and length of postoperative stay. Transfusion triggers were at the discretion of treating clinicians and were unchanged between the two cohorts; the majority of clinicians targeted Hb levels >7 g/dL (>10 g/dL in high risk cardiac patients) in line with a restrictive transfusion practice [12,13] or transfused for active bleeding with any haemodynamic instability. The number of units transfused was also at the discretion of the treating clinician; single unit transfusions are rarely used in our unit.

Data was collated using Excel (Microsoft, Washington) and categorical variables were compared using Fisher's Exact test whilst continuous variables were compared using student's t-test.

3. Theory

3.1. Rationale for intravenous iron use

In recent years, use of intravenous (IV) iron has become more popular, due to the development of newer formulations with less side effects [14] and its quicker onset of action compared to oral iron [9]. Newer IV iron formulations are easier to administer in comparison to previous compounds; our unit uses ferric carboxymaltose which does not require a test dose and can be administered over 15 minutes [14].

Keeler et al. have shown that a single dose of IV iron results in a mean rise in Hb of 1.65 g/dL in non-transfused anaemic patients with colorectal cancer, when given at least 14 days preoperatively [15]. IV iron has significant advantages over oral iron in both correcting preoperative anaemia and maintaining higher postoperative Hb levels [9], results in significantly lower perioperative transfusion rates compared to oral iron administration and is associated with a shorter length of hospital stay [16].

3.2. Rationale for intervention

Correcting anaemia has been shown to be associated with improved patient outcomes with reduced perioperative transfusion rates [17,18], less perioperative complications [17], shorter hospital stays [19] and reduced mortality rates [20]. Indeed, for every 1 g/dL increase in preoperative Hb, the likelihood of requiring a perioperative transfusion is reduced in the order of 40% [15]. Perioperative transfusion has also been associated with increased risk of

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