Anaemia represents the most frequent systemic manifestation of inflammatory bowel disease (IBD), and may not only affect quality of life and the ability to work, but also lead to an increased hospitalisation rate in these patients. Although the causes of anaemia in IBD are multifactorial, iron deficiency anaemia (IDA) and anaemia of chronic disease (ACD) are the most prevalent. In a condition associated with inflammation, such as IBD, assessment of iron status using the common biochemical values is insufficient. However, new iron indices such as reticulocyte haemoglobin content (CHr), percentage of hypochromic red cells (%HYPO) or zinc protoporphyrin (ZPP), may help to improve the assessment of iron status in IBD. Common treatment of IDA traditionally involves oral iron supplementation. However, because of extensive gastrointestinal side effects and data showing the use of oral iron in IBD to be possibly associated with disease exacerbation, recent guidelines suggest that, in IBD, the intravenous administration of iron supplementation should be preferred. On the basis of new experimental and clinical findings on the regulation of iron homeostasis, this article discusses improved diagnostic and therapeutic strategies, with special emphasis on new intravenous iron preparations.
Pathophysiology of IDA in IBD

Anaemia in IBD is multifactorial (Table 1). However, the most common causes of anaemia in IBD are considered to be iron deficiency as a result of chronic blood loss and/or reduced iron absorption and reduced intake, as well as anaemia of chronic disease, ACD, described for the first time by Cartwright in 1966. Although uncommon, Vitamin B12-folate deficiency and drug-induced anaemia (sulfasalazine, thiopurines, methotrexate, calcineurin inhibitors) should also be born in mind (Table 1).

The human body stores about 3 grams of iron (40-50 mg/kg BW), while daily iron losses (desquamation of the epithelial cells of the skin, the gastrointestinal tract, the bile ducts and the urinary tract, and blood loss during menstruation) average 1 to 2 mg. Mammalian iron homoeostasis is controlled solely by means of iron absorption from the duodenum (and to lesser extension in the proximal jejunum) in both the healthy and the inflamed state, and is tightly regulated by hepcidin (Fig. 1).

Hepcidin is an antimicrobially acting acute-phase protein, about 25 amino acids in size, which binds to the basolateral transporter, ferroportin triggering its tyrosine phosphorylation and internalisation by binding JAK2, leading to ubiquitin-mediated degradation in lysosomes. Removal of ferroportin from the plasma membrane increases the enterocyte iron content, which leads secondarily (but physiologically less relevantly) to a reduction in the expression of DcytB and DMT1. Moreover, hepcidin reduces the iron release from macrophages and monocytes.

Diagnostic work-up of iron deficiency in IBD

Anaemia is defined by the WHO as a decline in blood haemoglobin to a concentration of <12 g/dl (120 g/l) in women and <13 g/dl (130 g/l) in men. These parameters can equally be applied to patients with IBD. However, when determining anaemia on the basis of haemoglobin levels, it is important to take account of pregnancy, altitude, cigarette smoking, and possibly ethnicity. In view of the latter, the WHO has defined differentiated international cutoff values of haemoglobin and haematocrit (Table 2).

Normally, low mean cell volume (MCV) and low mean corpuscular haemoglobin (MCH) are reliable parameters of iron deficiency. However, a normal mean corpuscular volume (MCV) does not exclude iron deficiency as the cause of the anaemia, since up to 40% of “pure” IDA cases are normocytic (e.g. in IBD patients treated with azathioprine or 6-MP). Conversely, low MCV does not necessarily imply ID, as in the presence of ACD it can be normal or low. The accuracy of diagnosis for IDA can be improved substantially by including iron metabolism parameters.

Serum ferritin

Serum ferritin is an indicator of the storage iron content of the reticulohistiocytary system (RES), and

<table>
<thead>
<tr>
<th>Frequentely</th>
<th>Occasionally</th>
<th>Rarely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron deficiency</td>
<td>Vitamin B12 / folic acid deficiency (medicament-induced =&gt; Sulfasalazine, Thiopurine)</td>
<td>Haemolysis</td>
</tr>
<tr>
<td>Anaemia of chronic disease (ACD)</td>
<td></td>
<td>Myelodysplastic syndrome</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chronic renal insufficiency</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aplasia (mainly medicament-induced)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Congenital haemoglobinopathy or erythropoiesis disorders</td>
</tr>
</tbody>
</table>
Iron Deficiency Anaemia in Inflammatory Bowel Disease

**Table 1: Etiology of Anaemia in IBD.**

<table>
<thead>
<tr>
<th>Etiology</th>
<th>Frequently</th>
<th>Occasionally</th>
<th>Rarely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron deficiency</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anaemia of chronic disease (ACD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin B12/folic acid deficiency</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(medicament-induced =&gt; Sulfasalazine, Thiopurine)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haemolysis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Myelodysplastic syndrome</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chronic renal insufficiency</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aplasia (mainly medicament-induced)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Congenital haemoglobinopathy or erythropoiesis disorders</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 1:** Hepcidin as the master regulator of iron homeostasis in IBD.

Hepcidin gene expression is up-regulated during inflammation by proinflammatory cytokines - mainly IL-6 (involving JAK-dependent activation of STAT3). Hepcidin binds to ferroportin and triggers its lysosomal degradation, leading to a reduction in iron release from enterocytes and macrophages. Hepcidin may also inhibit DMT1 directly. Hepcidin levels are correlated with the body's iron stores. BMP regulates hepcidin by sensing enteric iron status. Iron absorption in enterocytes leads to activation of BMP6 expression and, subsequently, to the delivery of BMP6 to the liver. In the liver, BMP6 binds to type I and II receptors (BMPR1 and BMPR2) and to the co-receptor HJV, leading to phosphorylation of SMAD1, SMAD5 and SMAD8, and complex formation with SMAD4. This complex translocates to the nucleus to activate the HAMP gene promoter, leading to synthesis of hepcidin. Abbreviations: BMP, bone morphogenetic protein; DMT1, divalent metal transporter 1; HJV, haemojuvelin; IL-6, interleukin 6 (adapted from4)

is therefore used to detect malfunctions in cellular iron storage. Reduced concentrations are an indication of iron deficiency. A serum ferritin level below 15 μg/l is regarded as an indication of absolute iron deficiency. Since both inflammation and intracellular iron accumulation lead to increased serum ferritin levels, changes of serum ferritin in IBD must be interpreted in the context of the inflammation status.4,13 Recent guidelines therefore recommend that, in the presence of inflammation (i.e. CRP > 5), sensitivity and specificity can be improved by using a cut off value ≤ 100 μg/l.13,14

**Transferrin saturation**

Transferrin saturation is a measurement of the iron (continued on page 22)
content of the circulating transferrin. It does not, however, provide any information about the condition of the iron stores, giving only an indirect indication of the extent of iron utilisation. A suboptimal supply of iron for erythropoiesis is assumed where values are below 16%. While a reduced transferrin saturation has a relatively high sensitivity (90%) for detecting iron deficiency conditions, its specificity (40-50%) is relatively low.4

**Soluble transferrin receptor**
The number of transferrin receptors (TfR) on the cellular membranes continuously moving into the plasma is up-regulated in all cases of functional iron deficiency and is not influenced by chronic inflammation or hepatic damage. The measurement of soluble transferrin receptors (sTfR) has therefore been reported to be a reliable indicator of iron deficiency.15 However, since concentrations of sTfR are also increased in every expansion of erythropoiesis (i.e. haemolytic anaemia, thalassaemia or polycythaemia) and reduced in aplastic anaemia and other conditions with hypoproliferative erythropoiesis (i.e. renal anaemia), this assay has been found to have a specificity for IDA of 84% and a PPV of only 54%, and has been shown to be less accurate than serum ferritin.16

Similarly, attempts to combine ferritin and sTfR (sTfR/log ferritin ratio), as recommended by Punnonen,17,18 did not facilitate a more accurate differentiation between IDA and ACD.19,20

**Hypochromic erythrocytes/reticulocytes**
Recently, Thomas et al. were able to demonstrate that cytometry of the reticulocyte haemoglobin content (CHr) and the percentage of hypochromic red cells (%HYPO) has a high predictive value in the differential diagnosis of iron deficiency anaemia, even in the presence of inflammation and ACD.17,19 Whereas a reduction in %HYPO (mean lifetime of 120 days) indicates a deficient iron supply of longer duration, reduced CHr (mean lifetime of 48 hours) is an indicator of current iron deficiency, providing an accurate measurement of bioavailable iron over the previous 3–4 days (Table 3). In haemodialysis patients, it has been shown that CHr <29 pg also more accurately predicts functional iron deficiency than combined use of ferritin and TSAT, and furthermore, that CHr measurement may be able to predict the response to intravenous iron therapy within 2–4 days after onset.17,19

**Zinc protoporphyrin**
The potential use of zinc protoporphyrin (ZPP) as an indicator of ID was described by Dagg and colleagues as early as 1966.21 In the terminal reaction in haem synthesis – catalysed by the mitochondrial enzyme ferrochelatase - iron is chelated by protoporphyrin,
Iron Deficiency Anaemia in Inflammatory Bowel Disease

whereas iron and zinc can compete for the metal-binding site on ferrochelatase. Should the iron supply for erythropoiesis become suboptimal, ZPP is produced instead of haem, incorporating zinc instead of iron into protoporphyrin IX. Thus, ZPP directly reflects iron status in the bone marrow during erythropoiesis. ZPP does not respond to ACD or other chronic inflammation, and is therefore an effective indicator of ID even in the presence of inflammation.

Figure 2: Work-up for the management of IDA in patients with inflammatory bowel disease. Hb: Haemoglobin; TSAT: Transferrin saturation; HYPO: hypochromic erythrocytes; Chr: reticulocyte-Hb; ESA: Erythropoiesis stimulating agent (adapted from4)
Iron Deficiency Anaemia in Inflammatory Bowel Disease

INFLAMMATORY BOWEL DISEASE: A PRACTICAL APPROACH, SERIES #73

Table 3: Laboratory findings in IDA, ACD and in mixed IDA/ACD

<table>
<thead>
<tr>
<th>Laboratory Measures</th>
<th>normal</th>
<th>IDA</th>
<th>ACD</th>
<th>IDA/ACD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bone marrow iron</td>
<td>2-3</td>
<td>0-1</td>
<td>2</td>
<td>1-2</td>
</tr>
<tr>
<td>Serum iron</td>
<td>40-165 µg/l</td>
<td>(↓)</td>
<td>↓</td>
<td>↓ or n</td>
</tr>
<tr>
<td>Mean corpuscular volume</td>
<td>80-96 fl</td>
<td>↓</td>
<td>↓</td>
<td>↓ or n</td>
</tr>
<tr>
<td>Serum ferritin</td>
<td>16-350 µg/l</td>
<td>↑</td>
<td>↑</td>
<td>↑ or n</td>
</tr>
<tr>
<td>Transferrin</td>
<td>↑</td>
<td>↑</td>
<td>↓</td>
<td>↓ or n</td>
</tr>
<tr>
<td>Transferrin saturation</td>
<td>20-50%</td>
<td>↑</td>
<td>n or ↓</td>
<td>↑ or n</td>
</tr>
<tr>
<td>*sTfR</td>
<td>0.8-2.2 mg/l</td>
<td>↑</td>
<td>n or ↓</td>
<td>↑ or n</td>
</tr>
<tr>
<td>*sTfR-F index</td>
<td>high (&gt;2)</td>
<td>high (&gt;2)</td>
<td>low (&lt;1)</td>
<td>high (&gt;2)</td>
</tr>
<tr>
<td>CHe</td>
<td>≥ 29 pg</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
</tr>
<tr>
<td>PHRC</td>
<td>1-5%</td>
<td>&gt; 5%</td>
<td>&lt; 5%</td>
<td>≥ 80</td>
</tr>
<tr>
<td>*Zinc protoporphyrin</td>
<td>&lt; 40 (µmol/mole haem)</td>
<td>&gt; 80</td>
<td>≥ 80</td>
<td>≥ 80</td>
</tr>
<tr>
<td>C-reactive protein</td>
<td>&lt; 5 mg/l</td>
<td>n</td>
<td>↑↑</td>
<td>↑</td>
</tr>
<tr>
<td>Hepcidin</td>
<td>≤ 10 µg/l</td>
<td>↓</td>
<td>↑↑</td>
<td>n or ↓</td>
</tr>
</tbody>
</table>

*values vary according to the different assays; CHe = Reticulocyte haemoglobin content; PHRC= Percentage of hypochrome erythrocytes; sTfR= Serum transferrin receptor; sTfR-F= Soluble transferrin receptor/log ferritin

Treatment of IDA in IBD

Iron supplementation should be administered in all cases of manifest anaemia. In cases of iron deficiency without manifest anaemia, an individualised approach is required. The choice of timing and type of therapy is determined here by the symptoms, etiology, degree of severity, dynamics of the haemoglobin decrease, comorbidities and risks of therapy. The major goals of therapy for IDA are to supply sufficient iron to increase haemoglobin levels by >2 g/dl or increase them to normal values within 4 weeks, to replenish iron stores (transferrin saturation >30%), to relieve anaemia-related symptoms, and to thereby improve quality of life. Transferrin saturation levels >50% and ferritin levels >800 g/l are considered toxic and should be avoided.

In current practice, the Ganzoni Formula (Iron deficit [mg] = body weight [kg] x (target Hb-actual Hb [g/dl] x 2.4) + stored iron (500 mg)) is used to calculate individual iron requirement. However, this formula is inconvenient, error-prone and inconsistently used in clinical practice, and underestimates iron requirements. A comparison of the efficacy and safety of a novel fixed-dose regimen (Table 4) of ferric carboxymaltose (FERGIcorr) with individually Ganzoni-calculated doses of iron sucrose (IS) in IBD patients with IDA demonstrated better efficacy and a good safety profile compared to the Ganzoni-calculated dose regimen. Iron supplementation can be administered orally, intramuscularly or intravenously.

Oral iron administration

For many years, oral iron supplementation has been the preferred therapy. Despite the recommendations of international expert guidelines, the use of IV iron preparations has been considered a last resort due to safety considerations.

Oral iron preparations are available in the form of iron(II) salts (e.g. iron sulfate), iron(III) polymaltose complex (e.g. Maltofer) or haem iron polypeptides. Oral intake of iron(II) or iron(III) compounds is possible in IBD patients if there are no absolute indications for intravenous therapy (see below.), and in IBD patients with mild anaemia (Hb > 10 g/dl) and inactive disease oral iron replacement can be used. However, as more than 90% of ingested iron remains unabsorbed, oral iron preparations frequently lead to the occurrence of gastrointestinal adverse effects, including nausea, flatulence, diarrhoea and gastric erosion. Moreover, animal and human studies indicate that the generation of reactive oxygen species (Fenton reaction) by non-absorbed iron can potentially lead to the exacerbation of...
Iron Deficiency Anaemia in Inflammatory Bowel Disease

Therefore, when oral iron supplementation is initiated, the patient’s response, tolerance and adherence should be monitored. In patients who respond poorly (Hb increase < 2 g/dl within 4 weeks) or are intolerant to oral iron, as well in those with severe IDA (≤ 10 g/dl) and active disease (CRP > 5 mg/l), intravenous iron should be used as first-line therapy.13,14

Intramuscular iron supplementation
Intramuscular (i.m.) iron has been recommended as a safer and more effective alternative to oral and intravenous iron supplementation. However, administration of iron by intramuscular injection is painful and may lead to localised cutaneous siderosis. There are also concerns that considerable amounts of i.m.-administered iron may remain unabsorbed, and that the absorption rate may vary considerably. Since there is no clear clinical evidence demonstrating intramuscular iron application to be either less toxic or more effective than oral or intravenous iron, this method of iron supplementation should not be used.4

Intravenous iron administration
Intravenous iron therapy is advised for iron-deficient patients intolerant or unresponsive to oral iron supplementation (e.g. those demonstrating an insufficient increase in serum iron parameters within the first two weeks of treatment), patients with severe anaemia (Hb level < 10g/dl), those who have pronounced disease activity, and those being treated with ESAs.13,14 However, despite a number of observational and controlled studies in UC and CD patients having clearly demonstrated that IV iron is not only clinically effective but also very safe, gastroenterologists still seem hesitant to administer iron intravenously, fearing hypersensitivity reactions.31

Six intravenous iron preparations are now available that have a good safety record in other diseases (Table 5). Of these, iron sucrose (IS) has become standard of care in IBD in the past 10 years, due to its proven efficacy, wide availability and excellent safety record.32-38 However, the required number and frequency of doses (maximum dose 600 mg per week) and duration of administration (3.5 hours for a 500 mg dose) limit the practicality of IS for the achievement of high-level iron repletion.

In the past few years, a novel generation of so-called Type I intravenous iron preparations has been approved, allowing administration of high single doses (so-called “total dose infusions, TDi”). Data in IBD patients are as yet available only for LMW iron dextran preparations and ferric carboxymaltose.

The efficacy and safety of LMW - iron dextran preparations i.e. (Cosmofer®) in IBD patients with IDA have been studied both in children39 and in adults,40,41 demonstrating a significant haematopoietic response. However, iron dextrans have been associated with the occurrence of IgE-mediated anaphylactic reactions, reported in these studies to be 2-6% in spite of a successful test infusion.40,41 Although LMW - iron dextran preparations allow the total iron dose to be given in only 1-2 Infusions, the necessary infusion time of 4-6 hours must be considered an additional disadvantage. However, administration of LMW-iron dextran at this dose level is time consuming, taking some 4-6 hours. This not only inconvenient, but also reduces patients productivity.

Ferric carboxymaltose (Ferinject®) is a stable, macromolecular (150 kDalton) ferric hydroxide

<table>
<thead>
<tr>
<th>Hb [g/dl]</th>
<th>BW &lt;70 kg</th>
<th>BW ≥70 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥10</td>
<td>1000 mg</td>
<td>1500 mg</td>
</tr>
<tr>
<td>&lt;10</td>
<td>1500 mg</td>
<td>2000 mg</td>
</tr>
</tbody>
</table>

*Total dosage was administered in single infusions of 500 or 1000 mg iron as FCM
For patients with a body weight <67 kg, single doses of 500 mg were given
Iron Deficiency Anaemia in Inflammatory Bowel Disease

Iron dextran (LMW) 165 kD
Iron gluconate 37.5 kD
Iron sucrose 43.3 kD
Iron carboxymaltose 150 kD
Ferumoxytol 731 kD
Iron somaltoside 150 kD

Complex stability High Low Moderate High High High
Test dose required Yes No Yes No No No
Maximum approved dose 20 mg/kg BW 62.5 mg 200 mg* 1000 mg if patient weight > 66 kg 200 mg/kg BW
Maximum approved dose 200 mg 62.5 mg 200 mg 200 mg 510 mg 200 mg
Maximum Infusion period 360 min 30 min 210 min 15 min 17 sec 15 min
Maximum single dose on injection 200 mg 62.5 mg 200 mg 200 mg 510 mg 200 mg
Minimum Infusion period 2 min 10 min 10 min Bolus 17 sec Bolus
Dose-related reactions Hypotension, oedema Hypotension, oedema Hypotension, oedema None reported None reported None reported
Relative risk of severe side effects Moderate Low Very low None reported Very low None reported

*In most countries the dosage is fixed to 200 mg (label), in some countries 500 mg are approved.
Iron Deficiency Anaemia in Inflammatory Bowel Disease

INFLAMMATORY BOWEL DISEASE: A PRACTICAL APPROACH, SERIES #73

carboxymaltose was markedly better in correcting anaemia than iron sucrose; more patients on ferric carboxymaltose showed haemoglobin values increased by ≥2 g/l, or achieved normalisation of haemoglobin levels, than with IS. Moreover, FCM was much more convenient for patients, as a mean of 2.1 fifteen-minute infusions was necessary for successful treatment, as opposed to 5.8 infusions of one hour duration in the iron sucrose group.25

Transient hypophosphataemia has been seen in some individuals treated with ferric carboxymaltose (e.g., 2.5% of patients in the Evestatiev trial25), although the potential consequences and clinical relevance of this phenomenon are, as yet, unknown, and early trials indicated unexplained differences in mortality rates between the treatment and control arms.51

Ferumoxytol (Feraheme®), an iron polyglucose sorbitol carboxymethyl ether complex approved by the FDA in June 2009 as an injectable formulation for the treatment of IDA in patients with chronic kidney disease (CKD), allows the rapid injection (<1 min) of up to 510 mg iron.52-54 This dose can be repeated at 3-8 day intervals. As there are no published data on higher doses, several visits are required to complete dosing. This, together with the recommendation in the current package insert for a 60-minute observation time, diminishes the advantages of the shorter infusion time.55

Since ferumoxytol has superparamagnetic properties, it may alter MRI images for up to 3 months post administration.56 Bearing in mind that the use of MRI techniques represents a substantial part of diagnostic procedure in IBD patients,37,58 this must be considered an additional disadvantage at least in the IBD population.4 To date, there are no data available using Ferumoxytol for the treatment of IDA in patients with IBD.

Iron isomaltoside 1000 (Monofer®), the newest IV iron product, has a very low immunogenic potential and a very low content of labile and free iron.59 Monofer can therefore be administered as a rapid high-dose infusion in doses exceeding 1000 mg, without the application of a test dose. This offers considerable dose flexibility, including the possibility of providing full iron repletion in a single infusion (one-dose iron repletion). Iron isomaltoside 1000 was clinically well tolerated, safe and effective - nineteen treatment-related AEs occurred in 13 patients (7.1%) after 584 treatments (3.3%). No anaphylactic or delayed allergic reactions were observed. This new intravenous iron may offer a further valuable choice in treating the anaemia of CKD60. As in the case of Ferumoxytol, there are no data available for IBD.

Erythropoiesis-stimulating agents

In some patients, treatment of the underlying IBD in conjunction with iron, folic acid and vitamin B12 supplementation is not sufficient to effectively correct anaemia. In such cases, treatment with erythropoiesis-stimulating agents (ESA) is a valid option.61 A randomised clinical trial demonstrated that erythropoietin combined with IV iron was efficacious in correcting anaemia in a majority of IBD patients, and this has been confirmed in other studies.34,61,62 However, there are limited data on the exact dose and drug to be used, and in this rapidly changing field, local expertise from haematologists or nephrologists can be helpful.61

Increased erythropoiesis requires additional iron for the production of haem; iron supply is regarded as optimal when the transferrin saturation is calculated to be 30–40% and the serum ferritin concentration amounts to 200–500 μg/l. Therapy with erythropoiesis-stimulating agents should therefore always be combined with intravenous iron administration, as functional iron deficiency can essentially always be expected.4,13

It should be kept in mind that the use of ESA is a risk factor for thrombosis,63,64 an otherwise common complication in IBD and particularly in UC. Extensive experience in oncology and nephrology65-69 suggests that the therapeutic goal under ESA should therefore be 11-13 g/dl haemoglobin. However, it is not clear whether this can equally be applied to treatment of anaemia in IBD patients.14 Figure 2 summarises a treatment algorithm for iron replacement in IBD patients.

SUMMARY

Despite the introduction of newer intravenous iron preparations with improved safety profiles during the last decade, and despite the recommendations of international expert guidelines, practitioners seem still hesitant to administer iron intravenously. However, intravenous iron preparations of the new generation (which allow the administration of doses up to 1000
mg in a single session and require a much shorter application time) have been demonstrated to be safe and effective in a broad spectrum of diseases associated with IDA, so that the current recommendation for the use of oral iron as first-line therapy must be reconsidered. Furthermore, IV iron is the preferred method of iron supplementation as an adjunct to ESAs in patients with IBD. Intravenous iron can be given in multiple smaller doses or as a single total-dose infusion. The cumulative dose of IV iron that is needed to increase the Hb level into normal range and to replenish iron stores should be calculated using the new FERGICorr- instead of the Ganzoni-formula.

References

35. Schroeder O, Mickisch O, Seidler U, de Weert A, Dignass AU,
Iron Deficiency Anaemia in Inflammatory Bowel Disease

INFLAMMATORY BOWEL DISEASE: A PRACTICAL APPROACH, SERIES #73


