Abnormal FBC

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References:
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5. King College Hospital Mar 2017
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9. BUKU haematology app, accessed Dec 2020
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11. British Society of Gastroenterology guidelines for the management of iron deficiency anaemia in adults, 2021.
12. North West London haematology guidelines.
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Blood film

- Acanthocytes → - Irregularly edged cells due to: - Artefact. - Liver disease. - Alcohol excess.
- Anisocytosis → - Abnormal variation in RBC size due to: - Iron deficiency anaemia, especially if mixed with folate deficiency - Thalassaemia. - Megaloblastic anaemia. - Sideroblastic anaemia. - Sepsis. - Blood transfusion - the host and infused blood cells having different sizes.
- Atypical lymphocytes → - Virally-activated lymphocytes. - Less commonly seen in lymphoproliferative disease. - Report will usually advice if should be concerned about lymphoproliferative disease.
- Howell-Jolly bodies → Small nuclear inclusions in RBC seen in splenectomised or hypo/asplenic e.g. coeliac disease.
- Hypochromasia: → Seen in iron deficiency anaemia and thalassaemia.
- Leokoerythroblastic → - Immature RBC and WCC seen in blood. - Due to sepsis which forces immature cells from the marrow. - Or infiltrative process invading the marrow.
- Poikilocytosis → Variable red cell shape due to: - Sepsis. - Anaemia.
- Polychromasia → - RBC with different colours i.e. at different stages of maturation due to: - Marrow stress. - Haemolysis.
- Schistocytes → - Fragments i.e. a sign of intravascular haemolysis due to: - DIC. - Microangiopathic haemolytic anaemia.
- Spherocytes → - Spherical RBC due to: - Haemolysis. - Congenital hereditary spherocytosis.
- Target cells → - Liver disease. - Inherited Hb disorders.
- Tear drop cells → - Myelofibrosis.

Leucocytosis (WCC > 11)

- WCC 11 - 20 → - Blood film/WBC differential. - Assess for reactive causes. - Lymph node/spleen exam. (→ - Smoking. - Infection. - Inflammation. - Neoplasia.)
  - inconclusive or suspicion of haematological malignancy → - Routine refer to haematology.
- WCC 20 - 50 → persistent unexplained → - Routine refer to haematology.
- WCC 50 - 100 → - Blood film suggests chronic myeloid leukamia. - Leucoerythroblastic blood film picture. → - Urgent referal to haematology.
- WCC > 100 → - Blood film suggests chronic myeloid leukamia. → - Call on-call haematology STAT.
- - Blood film suggests chronic myeloid leukamia. → - CNS symptoms: - Headache. - Vomiting. - Visual loss. → - Call on-call haematology STAT.

Lymphocytopenia (Lymph < 1)

- Causes: - Elderly. - Malnutrition. - Immunosupressants. - Infection within 6/12. - HIV. - Hepatitis B & C. - OH excess. - Post surgery. - Systemic disease. - Lymphoma.
  - → - Renal failure. - Cardiac. - Liver. - Autoimmune disorders. - Lymphoma. - Sarcoidosis.
  - → - Unexplained 10% weight loss over 6/12. - Drenching night sweats. - Unexplained temp >38oC for 2/52.
- Lymphocytes <1 and red flag symptoms → Refer to appropriate speciality.
- If >0.5x109/L in >70y → - Nil needed.
- If no red flag symptoms repeat FBC in 6/52 and look for causes → - FBC and film. - UEs. - LFTs. - HIV. - ANA. - RF. - Serum immunoglobulins. → If no obvious cause and persistent over 6/12 refer routinely to haematology
- - Persistent lymphopenia remaining stable over 6/12, in the absence of symptoms, clinical findings or abnormal results from investigation does NOT require referral.

Lymphocytosis (Lymph > 4)

- Lymph 5-20 → look for any of following → - Anaemia. - Neutropenia. - Thrombocytopenia. - Progressive lymphadenopathy. - B symptoms. - Suspicious cells/ blasts on blood film.
  - → - Unexplained 10% weight loss over 6/12. - Drenching night sweats. - Unexplained temp >38oC for 2/52.
  - if any present → - Refer to haematologist urgently. → - UE's - Ca2+ - Ig - B2 immunoglobilins
  - if nil present → - Lymph node/spleen exam. - Blood film/WBC differential. - Glandular fever screen. - Exclude reactive causes. (→ - Smoking. - Other viral infections.)
    - reactive cause identified → - Repeat in 6/52 to confirm transient rise.
    - reactive cause not identified → - Refer to haematologist as routine. - Will want to rule out CLL.
      - → If assymptomatic and no anaemia or low Plt a 2ww is not appropriate because not high risk features.
      - → - Persistent lymphocytosis > 5. - Sustained for 3/12. - If <5 but proven monoclonal = monoclonal B lymphocytosis.
- Lymph > 20 → - Refer to haematologist urgently.

Eosinophilia

- → - Eczema. - Asthma. - Parasites. - Pemphigus. - Sarcoid. - Hodgkins. - Hyperoesinophilic syndrome. - Eosinophilic leukaemia.
- if referring → - Blood film. - CRP, ESR. - UEs. - LFT's. - Bone profile. - LDH. - Vitamin B12. - Allergy/atopy status. - Stool cultures for parasites. - CXR.
- Eos < 2.5 → - Monitor.
- Eos > 2.5 → - Refer to haematology.
- Eos > 10 → - Refer to urgently to haematology.

Neutropenia (Neut < 2)

- Neut < 1 → - More likely to have recurrent infections when < 1.
  - → - Anaemia. - Thrombocytopenia. - Lymphadenopathy. - Organomegaly. - Active sepsis. - B symptoms. - Suspicious cells/ blasts on blood film.
    - → - Unexplained 10% weight loss over 6/12. - Drenching night sweats. - Unexplained temp >38oC for 2/52.
    - → - Refer to haematologist urgently. OR - Discuss with on-call haematologist urgently.
- Neut 1-2 → - Blood film/WBC differential. - Exclude viral infection. - Autoimmune profile. - Check medication. - Consider ethnic neutropenia. - B12/folate deficiency.
  - → In Children also test following: → - CMV - HIV - LDH - Ig
  - → - Anti-ENA. - ANTI-DNA. - Rheumatoid factor. - C3, C4.
  - → - Middle east. - African. - Caribbean. → If no recurrent infections then more likely to be this.
  - → - Repeat FBC in 3-4/52. → - Cyclical neutropenia, changes weekly. - Complety benign condition. - Just do weekly FBC to detect it.
    - stable neutrophils → - Monitor every 3/12.
    - falling neutrophils → - Refer to haematologist.

Neutrophilia

- → - Post op. - Infection. - Steroids. - Smoking.
- - Neut <15 AND - well. → - Monitor.
- - Neut >15 OR - unwell. → - Refer to haematology.

Thrombocytopenia (Plt < 150)

- → - Virus (even 4/52 previously). - ITP (immune/idiopathic thrombocytopenic purpura) usually single figures. Dx of exclusion. - TTP (thrombotic thrombocytopenic purpura). - Alcohol. - H.pylori. - Hepatitis B & C. - Leukaemia. - Spurious. - HIV. - Lupus. - Connective tissue disorder.
  Note: for cataracts, hernia repair you just need Plt count of 50.
- → Note: does not protect against thrombosis e.g. DIC, ITP, Ca.
- - Ensure criteria not met for urgent referral. → - Plt <50. OR - Plt 50-100 and any following: - Severe anaemia/neutropenia. - MAHA. - Splenomegaly. - Lymphadenopathy. - Pregnancy. - Upcoming surgery. - History of thrombosis.
  - → - Unusual to get bleeding if Plt > 50. - Even Plt >20 in young pt is unlikely to allow bleeding.
  - → - Refer to haematologist urgently. OR - Discuss with on-call haematologist urgently.
  - → - MAHA = Micro-angiopathic haemolytic anaemia i.e. low Hb with the RCB breaking into fragments (blood film = schistocytes).
- - Repeat FBC to confirm. - Blood film. - Clotting screen. - Autoimmune profile. - Alcohol history/liver biochemistry. - Exclude viral infection. - HIV/Hepatitis screen. - TFT. - Check medication.
  - → 1st sample in normal EDTA tube. 2nd sample in citrate tube to prevent clumping.
  - → - ANA.
  - → - APTT. - PT. - Fibrinogen.
  - → - Anti-ENA. - ANTI-DNA. - Rheumatoid factor. - C3, C4.
  - 2o cause identified → - Treat as appropriate.
  - 2o cause not identified → - If >130 nil needed, not even repeat bloods if assymptomatic. - Refer to haematology but they will usually not see unless Plt < 100. - Why? - Because there is a low risk of bleed. - And if immune related only Rx is steroids and IV Ig which have lot's of s/e. - They do not treat to normal Plt counts, they treat to stop bleeding.

Thrombocytosis (Plt > 450)

- - Ensure criteria not met for urgent referral. → - Plt > 1000 - Plt > 450 and any of following: - Neurological symptoms - Abnormal bleeding - Recent thrombotic event: → - DVT/PE, TIA/CVA. - MI/unstable angina. - Vascular disease.
- - Repeat FBC to confirm. - CRP/ESR to look for reactive cause. - Check ferritin / iron kinetics. - Spleen exam. - Blood film. → - Infection. - Inflammation. - Post operative. - RTA. - Neoplasia.
  - 2o cause identified → - Treat as appropriate.
  - 2o cause not identified → - Refer to haematology. → - Will want to rule out essential thrombocythaemia which is a myeloproliferative disorder. - Clonal disease of bone marrow i.e. pre-malignant.

Polycythaemia (Hb > 18 (male) / 16 (female))

- 1o Polycythaemia (Polycythaemia rubra vera) → - ↑ Hb with a normal EPO i.e. the bone marrow is making excess RBC, independent of being told to make RBC from EPO.
- most commonly → 2o Polycythaemia → - Congenital heart disease. - Chronic lung disease e.g. COPD. - Sleep apnoea. - Lung Ca. - Renal Ca.
  - - Ensure criteria not met for urgent referral. → - Hct > 0.60 (males), > 0.56 (females) and absence of congenital cyanotic heart disease. OR - Persistently (two readings over 8/52) raised Hct > 0.51 (males), > 0.48 (females) and any of following: - Neurological symptoms. - Visual loss. - Abnormal bleeding. - Recent thrombotic event. - ↑ WCC count and/or ↑ PLT count. → - Refer to haematologist urgently.
  - - Repeat FBC to confirm result. Make sure hydrated ! - Blood film. - Spleen exam. - Check O2 saturation and exclude hypoxic inducing conditions. - Check for pruritus. - Modify lifestyle factors. - Check medication and stop diuretics. (→ - COPD. - Sleep apnoea.) (→ - Smoking.)
    - 2o cause identified → - HCT < 0.54 = monitor every 3/12 and treat underlying 2o cause. - HCT ≥ 0.54 = refer to hamatology for venesection. → - But do not refer if congenital heart disease as they need their polycythaemia to counteract their hypoxia.
    - 2o cause not identified → - Hct > 0.52 (male) or > 0.48 (female) for > 8/52, refer to haematology.

Anaemia

- → - Hb < 130 male. - Hb < 120 female (<110 pregnancy).
- → Refer to hameatology: - If fails to respond to iron replacement (Hb should increase by 1g / week). - If reticulocyte very low = bone marrow is not producing, so does not have ingredients, or has cancer which is crowding out develpment of reticulocyte. - If reticulocyte high = bone marrow is working overtime, or bone marrow trying to compensate for blood loss or destruction.

Microcytic (MCV < 76)

- Iron deficiency anaemia (IDA)
  - → - Dual pathology in up to 10% esp. elderly. - 10% is due to Ca. - Note: premenopausal women can have GI Ca. So justification for investigating younger women if the IDA is severe or recurrent, and disproportionate to perceived menstrual loss.
    - → Anaemia of chronic disease → - CKD. - CHF. - RA. - IBD. → - Especially likely when eGFR <30. - Interpretation of results is not the same as in pt's who don't have CKD. - Specifically, absolute iron def. is defined as transferrin saturation ≤20%, with ferritin ≤100 (in predialysis and peritoneal dialysis) or ≤200 (in haemodialysis).
    - → Chronic blood loss → GI: - Neoplastic e.g. colon Ca. - Inflammatory e.g. peptic ulceration, IBD. - Vascular malformations e.g. angiodysplasia. - Parasitic e.g. hookworm. GU: - Haematuria. - Gynaecological. Resp: - Recurrent epistaxis. - Haemoptysis. - Blood donation.
    - → Malabsorption syndromes → Hypochlorhydria: - Atrophic gastritis. - H.pylori. - Gastrectomy/gastric bypass. - PPI. Diet: - Vegan. - Poor dietary intake. Iron chelation: - Tea, coffee, calcium, flavonoids, oxalates, phytates - Antacids. Enteropathies: - Coeliac disease (3-5% of IDA). - Crohn s disease. - NSAID enteropathy. - Whipple s disease, bacterial overgrowth. - Small bowel resection/bypass. Genetic: - Iron-refractory iron deficiency anaemia. - Divalent metal transporter 1 deficiency anaemia.
  - → - ↓ MCH (mean cell Hb) i.e. hypochromia, is more sensitive than ↓ MCV. - Both MCH and MCV are less reliable in chronic disease, B12 / folate def. and in thalasaemia. - Ferritin <15 = absent iron stores. - Ferritin <30 = low body iron stores. - Ferritin can be high and appear normal if inflammation. So ferritin < 45 is considered a better cut off to balance sensitivity Vs specificity for detecting iron deficiency. And if >150 then unlikely absolute iron deficiency even if inflammation. - If your not sure if IDA, you can trial oral IRT (iron replacement therapy) for 2-4/52 and look for a ↑ Hb of ≥10-20, which is highly sensitive for absolute iron deficiency. - Absolute iron deficiency = body iron stores are inadequate to meet demands. - Functional iron deficiency = the supply of iron for erythropoiesis is inadequate despite apparently normal iron stores e.g. CKD, RA, IBD. - A good response to a trial of oral IRT suggests absolute iron deficiency rather than FID.
  - Investigations → - IDA should generally be referred to gastroenterology / gynae / urology as appropriate for further investigation. - Little consensus at what level of anaemia to investigate. - NICE 2ww = investigate IDA with Hb <110 in men or <100 in non-menstruating women. - These cut-off values will however, miss some cases of colorectal Ca, especially in men. - Hence, investigation should be considered at any level of anaemia in the presence of iron deficiency, though the case is stronger in those with more severe degrees of anaemia, as they are more likely to have serious underlying GI pathology.
    - - FBC. - Ferritin, transferrin saturation. - Coeliac disease serology. - Urine dip for blood. - Bidirectional endoscopy (abnormal in 1/3). - Risk score = www.predict-gi-risk-in-ida.com
      - ← ↓ Ferritin, ↓ MCH, new ↓ MCV, ↓ transferrin saturation, ↑TIBC
      - → - Anaemia is common in older people, > 20% if >85 years. - > 50% of nursing home residents. - Iron deficiency is a contributory factor in about half of cases. - Causes = poor diet, ↓ iron absorption, occult blood loss, medication (eg, aspirin) and chronic disease (eg, CKD, CHF). - BDE should be considered if IDA has been confirmed, or CT colonography if too frail. - But might not be worth risk if frail, lot's of comorbidities or ↓ life expectancy. So discuss with pt/family. → Gastroenterology consultant email: - Those who are fit and well with a lower biological (rather than their chronological age) should certainly be offered the opportunity of further investigation, given the relatively high Ca risk in this age-group. - At the other end of the spectrum, it would be entirely reasonable to manage those with high frailty scores and/or major co-morbidities, with empirical IRT without further investigation or indeed assessment in 2o care.
      - → LOW ferritin → Absolute iron deficiency confirmed. → Manage as IDA with investigations and treatment.
      - → NORMAL ferritin → Chronic disease / ↑ CRP, ↑ ESR (← - Since ferritin difficult to interpret with chronic inflammation it is important to use use clinical features e.g. GI symptoms, CRP, transferrin saturation, ↑ MCH and response to oral IRT to determine if GI investigations are needed.)
        - yes → ↓ Ferritin, ↓ MCH, new ↓ MCV, ↓ transferrin saturation, ↑TIBC
          - yes → Absolute iron deficiency probable. → Manage as IDA with investigations and treatment.
          - no → Absolute iron deficiency unlikley. → Good Hb response to oral IRT? → yes → Manage as IDA with investigations and treatment. / no → Consider anaemia of chronic disease or other causes.
        - no → No evidence of absolute iron deficiency.
      - → HIGH ferritin → No evidence of absolute iron deficiency. → Consider anaemia of chronic disease or other causes.
    - - Negative BDE, no evidence of coeliac, no other symptoms or cause found. → - Oral IRT.
      - → - Ferrous sulphate 200mg one tablet OD. OR - One on alternate days. OR - Two on alternate days.
      - → - If poor response consider adherence. OR - Continual loss e.g. angiodysplasia. → - Laxative for constipation. - Take with (or within 60 min of) food (but can ↓ absorption by 75%). - ↓ dose. - Switching to lower iron preparation (e.g. gluconate) is not supported by evidence. - Oral ferric maltol is more expensive than traditional iron salts, but considerably less expensive than parenteral. - Parenteral iron. - Note: Vitamin C has no effect on absorption. → - IV IRT may be preferable from the outset in those with ongoing significant bleeding, malabsorption, concurrent anaemia of inflammation, or issues with administration eg, severe dysphagia.
    - - Extreme symptomatic anaemia. → - Blood transfusion → - Blood transfusion is rarely required. - Most pt's have slowly developing anaemia so adapt to the resulting physiological stress. - Since parenteral iron reliably produces a clinically meaningful Hb response within a week, it should always be considered as an alternative. - Therefore, transfusion should be reserved for severe symptomatic and/or circulatory compromise. - Since a unit of packed red cells contains about 200 mg of elemental iron, it will not replenish the iron store deficit in severe IDA, and so should be followed by adequate iron replacement.
    - - Underlying cause found. → - Treat underlying cause. - Oral IRT.
    - - Recheck Hb in 4/52.
      - poor response to IRT → - If Hb not ↑ by 2g, is strongly predictive of subsequent failure to achieve a sustained haematological response. - In this situation, parenteral iron is more effective than continuing oral IRT. - For patients with intolerance or failure of Hb response at the 2-4/52, alternate day traditional iron salts (if not already used) or ferric maltol may be alternatives to parenteral iron on those with mild-moderate anaemia (Hb >95). - The tolerability and response should be assessed, and failure of the Hb to rise by 10 at 4/52 for alternate day iron, or 6/52 for ferric maltol, indicates the need for parenteral IRT.
      - complete and sustained haematological response to IRT → - IRT for 3/12 (to ensure adequate repletion of the marrow iron stores) then stop. - Then Hb at 3, 6, 12 and 24/12 to ensure no recurrence. - Or alternatively once normalised check Hb 3 monthly for 12 months and then 6-monthly for 2 3 yrs.
      - → - When to restart investigating? - Recurrence occurs in up to 25%. - Consider if repeat endoscopy required if previous is over 2yrs ago or had inadequate views. - If new symptoms e.g. wt loss, chronic unexplained diarrhoea etc. - Imaging of the renal tract should be considered regardless of the result of testing for microscopic haematuria, in view of the recognised association of renal cell carcinoma with IDA. - If this 2nd round of tests is all NAD, long-term IRT can be used (or irreversible e.g. atrophic gastritis, previous GI surgery).
- Thalassaemia → - In thalassaemia the MCV wil be disproportionately low compared to the Hb. - If MCV / RBC = < 13 suggests thalassaemia. - If MCV / RBC = > 13 suggests iron deficiency anaemia. - To confirm thalassaemia perform HbA2 test. - The ferritin, TIBC, and serum Fe will all be NAD. - Dont need to give iron to these pt's if iron stores replete. - But if transferrin saturation <20% is indicative of iron deficiency. → - HbA2 → 4-6% in thalassaemia trait.
- Sideroblastic → - Exremely rare.

Normocytic (MCV 76-96)

- Haemolysis
- Recent blood loss
- Myelodysplasia
- Chronic disease
  - → - Inflammatory cytokines supress the normal RBC production in the marrow. - Impair iron release from macrophages.
  - → - Chronic infection e.g. TB. - Rheumatoid arthritis. - IBD. - Cancer. → - Refer to haematology to rule out myelodysplasia etc. - Will not respond to iron supplements.
  - → REAL LIFE RESPONSE FROM BOWEL CANCER WEBINAR DEC 2024: You simply file the below - no action. This is not iron deficiency anaemia. A low HB with normal MCV and MCH is normochromic, normocytic anaemia which is very common in chronic disease patients e.g. if there is some renal disease, liver disease or if the pt has COPD or is a smoker. If the trend starts getting worse so the MCV and MCH start getting impacted, you can double check with iron studies which should be able to confirm the IDA and also check the ferritin. Worsening trends are more important than a single result in the grey areas.

05-Dec-2024	!	Full blood count - FBC	(MS2350) - Nothing to worry about. Result slightly out of range.
	!	Haemoglobin estimation	125 g/L (130 - 180)
		Total white cell count	5.40 10*9/L (4 - 11)
		Platelet count	322 10*9/L (150 - 450)
	!	Red blood cell (RBC) count	3.95 10*12/L (4.5 - 6.5)
	!	Haematocrit	0.377 L/L (0.4 - 0.52)
		Mean corpuscular volume (MCV)	95.4 fL (80 - 100)
		Mean corpusc. haemoglobin(MCH)	31.6 pg (27 - 32)
		Mean corpusc. Hb. conc. (MCHC)	332 g/L (320 - 360)
		Nucleated red blood cell count	0.00 10*9/L (0 - 0.2)
		Neutrophil count	2.55 10*9/L (2 - 7.5)
		Lymphocyte count	2.18 10*9/L (1.5 - 4.5)
		Monocyte count	0.50 10*9/L (0.2 - 0.8)
		Eosinophil count	0.11 10*9/L (0 - 0.4)
		Basophil count	0.06 10*9/L (0 - 0.1)

Detailed View

! Haemoglobin estimation

All data (6)

05-Dec-2024	125 g/L	Haemoglobin estim...
18-Nov-2021	131 g/L	Haemoglobin estim...
05-Oct-2020	131 g/L	Haemoglobin estim...
17-Dec-2019	128 g/L	Haemoglobin estim...
25-Sep-2015	134 g/L	Haemoglobin estim...

Trend

Macrocytic (MCV > 96)

- → - Mild macrocytosis is common. - Especially in young females. - Very often no cause is found. - Can occur during pregnancy too (B12 can also slightly drop, but not pathological). → - If well, watch and wait. - Can repeat FBC to ensure stable.
  - → - B12, folic acid. - LFTs. - TFT. - Immunoglobulins. - Alcohol intake. - Medication review. → - Trimethoprim. - Hydroxyurea. - Contraceptive pill. - Azathioprine. - Anticonvulsants.
  - → - ↑ MCV with any of following: - ↓ Hb. - ↓/↑ WCC. - ↓ Plt. - Elderly??? - Normal B12/folate??? → - Refer to haematologist.
- Hypothyroid
- B12/folate deficiency → - May show other abnormalities: - ↓ WCC. - ↓ Plt. - ↑ Bilirubin → - If pt is B12 deficient, and you give folic acid alone, you can theoretically precipitate sub acute combined degeneration of the cord. Because the tiny bit of B12 will be used up when the folic acid is introduced. - So correct B12 first. B before F. - If you unsure if both deficiences, simply replace both at the same time.
- Alcohol
- Liver diease
- Myelodysplasia → - Pre malignant disorder. - Often incidental finding. - Can progress to leukaemia.
  - → - Bipolar, hypogranular neutrophils. - Anaemia symptoms e.g. lethargy etc. - ↓ Plt (bruising, bleeding). - ↓ WCC (infections). → - Refer to haematologist.

Raised ferritin

Increased ferritin synthesis due to iron accumulation	Increase in ferritin synthesis not associated with significant iron accumulation	Increased ferritin as a result of cellular damage
Hereditary (genetic) haemochromatosis	Malignancies	Liver diseases including: liver necrosis, chronic viral hepatitis, alcoholic and non-alcoholic steatohepatitis[3]
Hereditary acaeruloplasminaemia	Malignant or reactive histiocytosis	Chronic excess alcohol consumption
Secondary iron overload from blood transfusion or excessive iron intake/administration	Hereditary hyperferritinaemia with and without cataracts	
Ineffective erythropoiesis: sideroblastic anaemia, some myelodysplastic syndromes (e.g. refractory anaemia with ring sideroblasts)	Gaucher disease	
Thalassaemias	Acute and chronic infections	
Atransferrinaemia	Chronic inflammatory disorders	
Ferroportin disease	Autoimmune disorders	

- LIVER DISORDERS → - Fatty liver. - Alcoholic and non alcoholic steatohepatitis (NASH). - Viral (usually shows normal TS). - LFTs. - USS liver. - GGT.
- RENAL DISORDERS → - Renail failure. - Ferritin is not a useful marker of iron stores in CKD, and is raised in nearly 50% on maintenance haemodialysis.
- MALIGNANCY → - Hepatocellular carcinoma. - Haematological malignancies. - Breast Ca. - Pancreatic Ca.
- INFLAMMATION → - Inflammatory conditions and acute or chronic infections. - Usually with elevated levels of CRP but normal TS.

- Raised ferritin → - Is an acute phase protein that contains 4000 iron atoms as Fe3+ ions. - Haemochromatosis is not common at all ! - Mort common reasons for ↑ ferritin are: - Liver disorders. - Renal disorders. - Malignancy. - Inflammation. - Haematological disorders. - Metabolic syndrome.
- → > 300 males. > 200 females. → - Be aware of considerable variation in ferritin with age, ethnicity and sex. - 20% of caucasian male adults = >300. - Females have > 200 in 3% aged 30-50, 10% aged 50-70y, and 17% aged >70 years. - Higher readings in black than caucasian.
- → - FBC. - LFTs. - GGT, viral hepatitis and liver USS if LFTs abnormal. - CRP. - Fasting transferrin saturation (TS). → This tells you if there is iron overload or not. → - Most patients without an elevated TS have raised ferritin due to inflammation, chronic alcohol consumption, cell damage, or metabolic abnormalities (e.g. obesity).
  - TS < 50% male <40% female → - Look for common causes e.g. liver, inflammation, obesity etc and treat. - If none then follow below options:
    - Patient well and ferritin < 1000 mcg/l → Lifestyle will lead to improvement -reducing alcohol -weight loss -reducing BP -improving diabetic control - Repeat ferritin and transferrin saturation after 3-6 months → - If still raised, refer to gastroenterology.
    - Ferritin >1000 mcg/l → - HFE gene test. - Refer to gastroenterology.
  - TS > 50% male >40% female
    - FBC = NAD → - HFE gene test. - Refer to gastroenterology.
    - FBC = abnormal → - HFE gene test -ve. - Refer to haematology.
- - Case study: - HFE result = compound heterozygous. - Haematology consultant = Your gene test has shown two different abnormal genes and most pt's with this condition do not accumulate excessive iron and as a result do not require treatment. - Your iron has been around 500 and therefore you do not need any treatment for that. - I would advice your GP to monitor your ferritin once a year and would be happy to see you again if your ferritin reaches > 2000.

Raised B12

- → - Haematology consultant reply = If the pt is clinically well and blood count normal, high B12 does not need further haematological investigations.
- → - The thinking is that high B12 might be due to myeloproliferative disorders. - Which are the myeloid line of cells? = RBC, Plt and neutrophils. - If these are all normal, then myeloproliferative disorder is excluded, so nil needed, and the isolated high B12 doesn't mean anything. - Liver disease can cause high levels, so do LFTs and liver USS. - UEs to rule out renal disease. - Other causes = eating lot's of soya, yeast or multivitamins.