UNDERSTANDING BLOOD TESTS

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Conflict of Interest: Nil
OVERVIEW

- Monitoring drug titration
- Markers of risk
- Iron deficiency
- Thyroid disease
- Tips and tricks
Practical recommendations for the use of ACE inhibitors, beta-blockers, aldosterone antagonists and angiotensin receptor blockers in heart failure: Putting guidelines into practice

John McMurray a,*, Alain Cohen-Solal b, Rainer Dietz c, Eric Eichhorn d, Leif Erhardt e,

- Commencing ACEi / ARB
  - Caution if Cr >220 umol/L or K+ >5 mmol/L
- Acceptable increases
  - 50% increase in Cr or Cr up to 266 umol/L
  - K+ up to 5.5 mmol/L
- Discontinue other drugs (NSAID, diuretics, MRA) before ACEi / ARB
- Stop ACEi / ARB
  - 100% increase in Cr or Cr >310 umol/L
  - K+ >5.5 mmol/L

McMurray J, Eur J Heart Fail 2005
MARKERS OF RISK
- IS YOUR PATIENT DETERIORATING…?
SEATTLE HEART FAILURE MODEL

- Derived from 1100 patients in the PRAISE trial
- NYHA III-IV, EF <30%
- Higher mortality:
  - Na <138 mmol/L
  - lower Hb
  - lower lymphocytes
  - lower cholesterol
  - higher uric acid
- Renal function not predictive of outcome

Levy WC, Circ 2006
MAGGIC SCORE

- 40,000 patients
- Creatinine the only blood test predictive of outcome

Pocock SJ, Eur Heart J 2013
NATRIURETIC PEPTIDES (NP)

- BNP (<100pg/ml) / NT-proBNP (<300pg/ml) used as rule out test for acute HF\textsuperscript{1,2}
- BNP (>400pg/ml) / NT-proBNP (>2000pg/ml) used to stratify patients for urgent assessment\textsuperscript{3}
- NP elevated with many conditions
  - LVH, ischaemia, tachycardia, hypoxia, low GFR, sepsis, COPD, DM, age >70yrs, liver disease
- Diuretics, ACE, ARB, MRA, CRT reduce NP\textsuperscript{4}
- BB may transiently increase NP for 2-3m before reducing\textsuperscript{5}
- BNP elevated with sacubitril-valsartan and so use NT-proBNP in these patients

\textsuperscript{1}NICE CG 187, Acute Heart Failure, 2014
\textsuperscript{2}ESC Guidelines for HF, 2016
\textsuperscript{3}NICE CG 108, Chronic Heart Failure, 2010
\textsuperscript{4}Motiwala SR, Clin Pharm Ther 2013
\textsuperscript{5}Davis ME, Circ 2006
NP AS PROGNOSTIC MARKERS

- VAL-HEFT study
- 35% increase in risk for each 100pg/ml rise in BNP

NP GUIDED THERAPY

Savarese G, PLoS ONE 2013
RENAL FUNCTION

- Cr >110umol/L associated with increased mortality in MAGGIC
- Rising urea also predicts mortality
- Correlate with clinical assessment of fluid status and symptoms
  - Relieving renal venous hypertension improves renal perfusion
  - Beware of GI blood loss
    - Normal Cr-Ur ratio approx 10:1
    - In GI bleeding, Cr-Ur ratio <3:1
- eGFR may be more accurate than Cr
  - Cr underestimates renal function in low muscle mass, elderly and women
- eGFR less reliable in AKI

1 Novack V, PLoS ONE 2010
HYponatraemia

- Sodium <136mmol in stable outpatients associated with risk of hospitalisation and death\(^1\)

- Water excess or sodium depletion?
- Assess fluid status, paired urine/serum osmolality and urine sodium
- Measure Mg\(^{2+}\), Ca\(^{2+}\) and K\(^+\)
- Beware of nephrotic syndrome, liver failure and hypothyroidism in oedematous patients

Bailing L, *Eur J Heart Fail* 2011
HYPONATRAEMIA ASSESSMENT

Is the patient dehydrated?

Yes

Is urinary Na > 20mmol/L?

Yes

(Na⁺ & H₂O lost via Kidneys)

Renal Failure
Diuretic Excess
Osmolar Diuresis
Addison’s disease

No

Diarrhoea
Vomiting
Burns
Trauma
Small bowel obstruction
Fistulae

No

Is the patient oedematosus?

Yes

Heart failure
Renal Failure
Nephrotic Syndrome
Liver cirrhosis

No

Is urine osmolality > 500mmol/Kg?

Yes

SIADH

No

Water overload
Severe Hypothyroidism
Glucocorticoid Insufficiency

Longmore M, Oxford Handbook of Clinical Medicine, 7th Ed, Oxford University Press 2007
LIVER FUNCTION TESTS

- Liver function tests comprise
  - Bilirubin
  - Alk Phos
  - Gamma GT
  - ALT
  - Albumin

- Consider other causes of abnormal LFT
  - Drugs (e.g. ETOH, Abx, statins)
  - Non-invasive liver screen
  - USS liver – cirrhosis, gallstones

Allen LA, Eur J Heart Fail 2009
HYPOALBUMINEMIA

• Common in HF

• Causes
  • Dilution?
  • Inflammation
  • Liver disease
  • Renal loss (nephrotic syndrome)
  • GI loss (protein losing enteropathy)

• Can consider replacing with iv Albumin if fluid overloaded

Horwich TB, Am Heart J 2008
DIAGNOSING OTHER CONDITIONS
IRON DEFICIENCY

• Very common in CHF and independent of anaemia

• Associated with higher NYHA class, hospitalisations and mortality

• iv iron improves exercise tolerance and reduces hospitalisations\(^1,2\)

\(^1\)Anker S, *NEJM* 2009
\(^2\)Ponikowski P, *Eur Heart J* 2014
IRON DEFICIENCY - BASICS
IRON DEFICIENCY – HEART FAILURE
IRON DEFICIENCY - DIAGNOSIS

- Ferritin <100 ug/L
- Transferrin saturation (TSAT) <20% (with Ferritin <300 ug/L)
- Microcytosis: MCV <80 fL

Diagram showing the various components and pathways involved in iron deficiency, including heme iron, nonheme iron, duodenal cytochrome B, DMT1, mucosal ferritin, ferritin, hephaestin, ferroportin 1, and hepcidin. The diagram also highlights the loss of iron through the shedding of epithelial cells and the role of transferrin in iron transport.
## IRON DEFICIENCY - DIAGNOSIS

<table>
<thead>
<tr>
<th>Condition</th>
<th>Serum Iron</th>
<th>Transferrin / TIBC</th>
<th>TSAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron deficiency</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Anaemia of chronic disease</td>
<td>Low</td>
<td>Low</td>
<td>Normal</td>
</tr>
<tr>
<td>Oral contraceptives</td>
<td>Normal</td>
<td>High</td>
<td>Low</td>
</tr>
</tbody>
</table>
SUMMARY

- Worsening NP, renal function, liver function, sodium and albumin may indicate deteriorating HF
- Correlate bloods with fluid status and symptoms
- Consider correcting iron deficiency with iv iron
- Consider alternative causes of abnormal bloods if it doesn’t fit with the HF
  - Hypothyroidism
  - Liver disease
  - Renal disease
  - GI blood loss