

# Case Studies

## AIMS National Scientific Meeting 2009

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**79 y.o. F.**

**Hospital in-patient**

**Na 97 (125-145)**

**K 12.9 (3.5-5.0)**

**CL 86 (98-108)**

**HCO<sub>3</sub> 14 (21-32)**

**UR 2.5 (3.0-8.0)**

**Glu 62 (3.0-11.0)**

## 65 y.o. F. - routine screen

<b>Na</b>	<b>141</b>	<b>(135-145)</b>
<b>K</b>	<b>10.3</b>	<b>(3.5-5.0)</b>
<b>CL</b>	<b>94</b>	<b>(98-108)</b>
<b>HCO3</b>	<b>28</b>	<b>(21-32)</b>
<b>Ca</b>	<b>0.59</b>	<b>(2.10-2.55)</b>
<b>PO4</b>	<b>0.95</b>	<b>(0.75-1.35)</b>
<b>ALP</b>	<b>12</b>	<b>(30-120)</b>

# EDTA contamination

## – di potassium EDTA

- adds K
- EDTA acts by chelating Ca
  - low Ca, low ALP
  - also low Fe, Zn, Mg

**58 y.o M.**

**CLL**

<b>Na</b>	<b>138</b>	<b>(135-145)</b>
<b>K</b>	<b>6.7</b>	<b>(3.5-5.0)</b>
<b>CL</b>	<b>95</b>	<b>(98-108)</b>
<b>HCO3</b>	<b>27</b>	<b>(22-33)</b>
<b>UR</b>	<b>8.0</b>	<b>(3.0-8.0)</b>
<b>Cr</b>	<b>0.09</b>	<b>(0.06-0.12)</b>

# Add some haematology

**Na**                    **138**                    **(135-145)**

**K**                      **6.7**                      **(3.5-5.0)**

**CL**                    **95**                      **(98-108)**

**HCO<sub>3</sub>**                **27**                      **(22-33)**

**UR**                    **8.0**                    **(3.0-8.0)**

**Cr**                    **0.09**                    **(0.06-0.12)**

**WCC**                    **35000**                    **(4 – 11.0)**

**Plt**                    **130000000**                    **(150 – 450)**

# Repeat on Plasma

<b>Na</b>	<b>139</b>	<b>(135-145)</b>
<b>K</b>	<b>4.6</b>	<b>(3.5-5.0)</b>
<b>CL</b>	<b>99</b>	<b>(98-108)</b>
<b>HCO3</b>	<b>25</b>	<b>(22-33)</b>
<b>UR</b>	<b>8.3</b>	<b>(3.0-8.0)</b>
<b>Cr</b>	<b>0.09</b>	<b>(0.06-0.12)</b>

47 y.o. F.

Hypertension

<b>Na</b>	<b>115</b>	<b>(135-145)</b>
<b>K</b>	<b>7.2</b>	<b>(3.5-5.0)</b>
<b>CL</b>	<b>85</b>	<b>(98-108)</b>
<b>HCO3</b>	<b>20</b>	<b>(23-33)</b>
<b>UR</b>	<b>19.1</b>	<b>(3.0-8.0)</b>
<b>Cr</b>	<b>0.15</b>	<b>(0.06-0.12)</b>

On spironolactone

Cort am                      250                      (140-690)

- Spironolactone acts by inhibiting the action of aldosterone on the distal tubules.
  - Promotes Na loss and K retention
  - Mimics mineralocorticoid deficiency

42 y.o. M.

Routine bloods

<b>Na</b>	<b>145</b>	<b>mmol/L</b>	<b>(132-144)</b>
<b>K</b>	<b>7.6</b>	<b>mmol/L</b>	<b>(3.2-4.8)</b>
<b>Cl</b>	<b>98</b>	<b>mmol/L</b>	<b>(98-108)</b>
<b>HCO<sub>3</sub></b>	<b>25</b>	<b>mmol/L</b>	<b>(23-33)</b>
<b>Urea</b>	<b>8.3</b>	<b>mmol/L</b>	<b>(3.0-8.0)</b>
<b>Creat</b>	<b>0.23</b>	<b>mmol/L</b>	<b>(0.06-0.12)</b>
<b>Gluc</b>	<b>--</b>	<b>mmol/L</b>	<b>(3.0-6.7)</b>
<b>Ca</b>	<b>2.41</b>	<b>mmol/L</b>	<b>(2.15-2.55)</b>
<b>PO<sub>4</sub></b>	<b>5.00</b>	<b>mmol/L</b>	<b>(0.6-1.25)</b>

25 y.o. M.

Routine screen

<b>TP</b>	<b>73 g/L</b>	<b>55 – 80</b>
<b>Alb</b>	<b>35 g/L</b>	<b>33 – 50</b>
<b>Tbil</b>	<b>62 umol/L</b>	<b>1 – 20*</b>
<b>cBil</b>	<b>7 umol/L</b>	<b>1 – 5*</b>
<b>ALP</b>	<b>105 U/L</b>	<b>35 – 120</b>
<b>GGT</b>	<b>15 U/L</b>	<b>5 – 60</b>
<b>AST</b>	<b>17 U/L</b>	<b>0 – 45</b>
<b>ALT</b>	<b>22 U/L</b>	<b>0 – 45</b>
<b>LD</b>	<b>165 U/L</b>	<b>120 – 250</b>

Fasting serum

# M 25 y.o. Routine screen

- **Gilbert's syndrome**
- **Possibilities**
  - **Gilberts syndrome, haemolytic states**
  - **Exclude haemolysis (AST/LD N)**

**haptoglobin, direct anti-globulin, reticulocyte count**

# Gilbert's syndrome

- Described by Augustin Gilbert in 1901
- Common: 3-8% population
  - More common in males
- Detected in times of stress: fasting, infection, menstruation, dehydration, exertion.
- Mutation in gene encoding the enzyme bilirubin UDP-glucuronosyl transferase → 30-50% of normal activity
- Essentially benign ?
  - small proportion may have difficulty with drug metabolism: aspirin, dopamine derivatives, irinotecan

## M 61 y.o. Alcohol++++

- Presents with 3 days anorexia, epigastric pain, dark urine
- O/E mild jaundice, firm enlarged liver

TP	73 g/L	55 – 80
Alb	35 g/L	33 – 50
ALP	168 U/L	35 – 155*
GGT	1515 U/L	5 – 60*
AST	127 U/L	0 – 45*
ALT	100 U/L	0 – 45*
LD	235 U/L	120 – 250

# YES

- The gross elevation in GGT
  - GGT/ALP ratio  $>5$
- The AST/ALT ratio being  $>1$
- ALP is partially inducible
- Other relevant tests might be triglycerides, urea, urate, MCV, CDT

# M 72 y.o. Nocturia, SOB

Na	120	135 – 144*	TP	158	55 – 80 *
K	4.8	3.2 – 5.5	Alb	27	33 – 50 *
Cl	100	94 – 105	Tbil	8	1 – 20
Bic	19	22 – 30*	ALP	61	35 – 115
Urea	20.2	3.0 – 7.6 *	GGT	56	0 – 60
Crt	612	50 – 120 *	AST	16	0 – 45
UA	789	150 – 500 *	ALT	18	0 – 45
Ca	2.05	2.10 - 2.60*	LD	198	120 – 250
iP	1.93	0.80 – 1.45 *			

# MGUS v MM

## MM

Monoclonal band >30g/L

Plasma cells >10% on BMBx

FLC possible

Immune paresis probable

Symptomatic myeloma

ROTI: related organ or tissue injury

Lytic bone lesions

Renal impairment

Hypercalcaemia

## MGUS

Monoclonal band <30 g/L

Plasma cells <10%

FLC possible.

Immune paresis possible

No ROTI

M. 50 y.o.

- Hip replacement several months ago.  
Last few days pain+++ in hip and limbs
- Admitted in a shocked state, cold and sweaty, BP 95/- mmHg
- Small volume dark urine was obtained by catheterisation. Positive for blood.

# Initial results

Na	119	135 – 144*	TP	91	55 – 80*
K	7.4	3.3 – 5.5*	Alb	38	33 – 50
Cl	85	94 – 106*	TBil	14	1 – 20
Bic	12	22 – 30*	ALP	134	35 – 100*
AG	29	11 – 19*	AST	6290	0 – 45*
Urea	18.3	3.0 – 7.6*	ALT	250	0 – 45*
Crt	450	50 – 120*	GGT	458	0 - 70*
UA	1164	150 – 500*	LD	5650	120 – 250*
Ca	1.27	2.10 – 2.60*			
iP	3.96	0.70 – 1.30*			

# Results

Na	119	135 – 144*	TP	91	55 – 80*
K	7.4	3.3 – 5.5*	Alb	38	33 – 50
Cl	85	94 – 106*	TBil	14	1 – 20
Bic	12	22 – 30*	ALP	134	35 – 100*
AG	29	11 – 19*	AST	6290	0 – 45*
Urea	18.3	3.0 – 7.6*	ALT	250	0 – 50*
Crt	450	50 – 120*	GGT	458	0 – 70*
UA	1164	150 – 500*	LD	5650	120 – 250*
Ca	1.27	2.10 – 2.60*			
iP	3.96	0.70 – 1.30*	CK	219000	35 – 190*

# Points to remember

- Rhabdomyolysis with massive CK elevation is clinically urgent.
- Dipstick positive urine for “blood” can be RBC, Hb, Mb
- Myoglobin deposition in kidney tubules leads to ATN → death if not treated urgently.

18 y.o M. iv drug user. Presents with  
anorexia, malaise

**O/E jaundice, mild hepatosplenomegaly and some  
lymphadenopathy in the neck area. The urine was  
positive for bilirubin.**

TProt	74	g/L	(60-80)
Alb	39	g/L	(30-50)
ALP	145	U/L	(30-120)
GGT	96	U/L	(<40)
ALT	591	U/L	(<40)
AST	471	U/L	(<35)
Bili	47	mmol/L	(<20)
LD	768	U/L	(50-200)

## Further tests:

- Hepatitis A, B, and C serology all negative.
- CBP revealed some atypical lymphocytes, (? Hepatitis-related, ? Glandular fever) and a Paul-Bunnell test was suggested, which was positive.
- **LD4 is the form of LD in IM**
  - Disproportionate increase in LD c.f ALT in a young person
    - think IM

# Albumin change ?

Request: 09 -4167648

12/3 13/3

T.Prot	66	60	68	75	73	(60 - 82)	g/L	
Alb.	40 *	26 *	31	39	38	(35 - 50)	g/L	*
ALP	115	87	115	82	90	(30 - 120)	U/L	
Bili.	10	9	13	7	9	(< 25)	umol/L	
GGT	* 163 *	100 *	116	32 *	62	(< 50)	U/L	*
AST	28	26	25	20	12	(< 41)	U/L	
ALT	30	15	19	14	12	(< 41)	U/L	
LD	101	110	96	119	68	(50 - 280)	U/L	

Glucose Reference Ranges \*

Random 3.0 - 6.9 mmol/L

Fasting 3.0 - 5.4 mmol/L

4467648 \*\* PROTEIN AND ALBUMIN TO BE RE-RUN AND CHECKED \*\*

specialist management noted.

-- START OF PRIVATE COMMENTS --

RESULTS ON HOLD: results have been withheld pending further laboratory

F1-Prev Form | F2-Help | F4-Return | F5-Zoom | F10-More Key

----- Press Enter for further results -----

# Albumin change ?

Request: 09 -4167648 AFRODITA SALAMON 08/06/1960  
 M 12/3 13/3 GEORGE RD ATHELSTONE MSU 13/03/2009

T.Prot	66	60	68	75	73	(60 - 82)	g/L	
Alb.	40 *	26 *	31	39	38	(35 - 50)	g/L	*
ALP	115	87	115	82	90	(30 - 120)	U/L	
Bili.	10	9	13	7	9	(< 25)	umol/L	
GGT	* 163	* 100	* 116	* 32	* 62	(< 50)	U/L	*
AST	28	26	25	20	12	(< 41)	U/L	
					12	(< 41)	U/L	
					68	(50 - 280)	U/L	

**RXL TP/Alb 68/29**  
**Sebia 28**

Glucose Reference Ranges \*  
 Random 3.0 - 6.9 mmol/L  
 Fasting 3.0 - 5.4 mmol/L

4467648 \*\* PROTEIN AND ALBUMIN TO BE RE-RUN AND CHECKED \*\*  
 specialist management noted.

-- START OF PRIVATE COMMENTS --  
 RESULTS ON HOLD: results have been withheld pending further laboratory F  
 F1-Prev Form | F2-Help | F4-Return | F5-Zoom | F10-More Key  
 ----- Press Enter for further results -----

# Albumin assay

- **Current status as reflected by RCPA-QAP**
  - **625 labs enrolled for albumin**
  - **230 BCP (395 BCG)**
  - **Performance overall appears to be very good. 82% meet ALP at low level**

# Albumin assay

- **Differences between BCP and BCG results in “sick” patients can vary by up to 14g/L**
  - Some studies have suggested a mortality of close to 100% in ICU patients with albumin <25 g/L.
  - Dieticians use 30 g/L as a cut-off for considering supplemental nutrition
  - Difference can mask raised globulin fraction
- **Renal patients: NKF recommend BCG.**
  - Small % of haemodialysis patients will have lower than true values by BCP due to competitive binding by CMPF, but BCG much higher than true value.
  - Dialysis unit audits use albumin as a KPI.
- **Even renal patients better served by BCP.**

# Albumin assay

**If albumin is to be used as a nutritional marker, especially in a hospital setting, method must be BCP**

- **If your lab uses BCG for albumin, consider whether this is optimal for your patients.**
- **Opportunity for Clinical Biochemists to liaise with clinical groups re best tests and interpretation**

# 80 y.o. F for review

MHOOL-HOOPMANN, M 4 CENTENARY AVE NORRISPTA 30/03/2009

MULTIPLE BIOCHEMICAL ANALYSIS

Date: 30/03/09:27/02/09:03/12/08:05/06/08:18/02/08  
Coll. Time: 09:35 08:50 09:45 09:05 09:10  
Request: 4504609 4111065 3459836 8228960 6748412

sodium	140	142	142	140	139	(136 - 146)	mmol/L
Potass.	4.0	4.0	4.2	4.1	3.9	(3.5 - 5.2)	mmol/L
chlorid	102	103	103	99	100	(98 - 109)	mmol/L
bicarb	24	20	28	20	20	(20 - 22)	mmol/L
Urea	* 22.2	* 13.8	* 11.4	* 7.7	* 14.2	(3.5 - 11.0)	mmol/L *
Creat.	* 184	* 121	* 121	* 125	* 144	(40 - 85)	umol/L *
eGFR	23	37	37	36	30		mL/min/1.73m2
Urate	** 0.94	* 0.69	* 0.59	* 0.54	* 0.53	(0.15 - 0.45)	mmol/L *
gluc.	* 7.5	5.7	4.8	5.1	5.2	(see below)	mmol/L *
chol	4.9	* 6.0			3.9	(< 5.6)	mmol/L *
Calc.	* 2.63	2.46	2.41	2.36	2.44	(2.10 - 2.55)	mmol/L *
ica	* 1.30	1.23	1.19	1.16	1.21	(1.07 - 1.27)	mmol/L
Phos.	1.40	1.28	1.23	1.16	1.36	(0.75 - 1.45)	mmol/L
T.Prot	77	76	76	77	75	(60 - 80)	g/L F

F1-Prev Form | F2-Help | F4-Return | F5-Zoom | F10-More Key  
----- Press Enter for further results -----

# 83 y.o. F Constipated

## MULTIPLE BIOCHEMICAL ANALYSIS

Date: 08/10/09:03/09/09:17/06/09:21/05/08:28/02/08  
 Coll. Time: 12:05 15:45 16:10 15:40 15:05  
 Request: 6643722 6636178 5249563 7678474 7347610

Sodium	140	140	138	138	138	(136 - 146)	mmol/L
Potass.	* 3.3	3.8	4.3	4.1	4.0	(3.5 - 5.2)	mmol/L *
Chlorid	* 96 *	97 *	92 *	96 *	94	(98 - 109)	mmol/L *
Bicarb.	* 36	32 *	34 *	34	32	(20 - 33)	mmol/L *
Urea	* 16.0	11.8	11.0	11.5	12.5	(3.5 - 13.0)	mmol/L *
Creat.	* 192 *	158 *	153 *	117 *	122	(40 - 85)	umol/L *
eGFR	21	27	28	37	36		mL/min/1.73m2
Urate	* 0.53 *	0.50 *	0.50 *	0.53 *	0.51	(0.15 - 0.45)	mmol/L *
Gluc.	3.8	4.7	5.6	4.0	4.5	(see below)	mmol/L
Chol	* 7.0 *	6.8 *	7.4 *	7.2 *	7.5	(< 5.6)	mmol/L *
Calc.	* 2.93 *	2.62 *	2.76 *	2.57 *	2.62	(2.10 - 2.55)	mmol/L
iCa	* 1.43 *	1.29 *	1.33	1.24	1.23	(1.07 - 1.27)	mmol/L
Phos.	* 1.60 *	1.54 *	1.75 *	1.47 *	1.60	(0.75 - 1.45)	mmol/L
T.Prot	73	77	73	81	87	(63 - 80)	g/L

F1-Prev Form | F2-Help | F4-Return | F5-Zoom | F10-More Key

----- Press Enter for further results -----

# On Rocaltrol!

Date: 08/10/09:03/09/09:17/06/09:21/05/08:28/02/08  
 Coll. Time: 12:05 15:45 16:10 15:40 15:05  
 Request: 6643722 6636178 5249563 7678474 7347610

Sodium	140	140	138	138	138	(136 - 146)	mmol/L
Potass.	* 3.3	3.8	4.3	4.1	4.0	(3.5 - 5.2)	mmol/L *
Chlorid	* 96 *	97 *	92 *	96 *	94	(98 - 109)	mmol/L *
Bicarb.	* 36	32 *	34 *	34	32	(20 - 33)	mmol/L *
Urea	* 16.0	11.8	11.0	11.5	12.5	(3.5 - 13.0)	mmol/L *
Creat.	* 192 *	158 *	153 *	117 *	122	(40 - 85)	umol/L *
eGFR	21	27	28	37	36		mL/min/1.73m2
Urate	* 0.53 *	0.50 *	0.50 *	0.53 *	0.51	(0.15 - 0.45)	mmol/L *
Gluc.	3.8	4.7	5.6	4.0	4.5	(see below)	mmol/L
Chol	* 7.0 *	6.8 *	7.4 *	7.3 *	7.5	(< 5.6)	mmol/L *
Calc.	* 2.93 *	2.62 *	2.76 *	2.57 *	2.62	(2.10 - 2.55)	mmol/L *
iCa	* 1.43 *	1.29 *	1.33	1.24	1.23	(1.07 - 1.27)	mmol/L
Phos.	* 1.60 *	1.54 *	1.75 *	1.47 *	1.60	(0.75 - 1.45)	mmol/L *
T.Prot	79	77	79	* 84 *	87	(60 - 80)	g/L <b>F</b>

F1-Prev Form | F2-Help | | F4-Return | F5-Zoom | | F10-More Key  
 ----- Press Enter for further results -----

# 72 y.o. F Routine

## MULTIPLE BIOCHEMICAL ANALYSIS

Date: 06/10/09:13/10/08:06/05/08:03/07/07:16/04/07  
 Coll. Time: 14:40 00:00 08:35 14:10 13:15  
 Request: 6633847 8616016 7614364 3016611 3391881

Sodium	137	140	145	136	144	(136 - 146)	mmol/L
Potass.	4.1	4.0	4.1 *	5.8	4.5	(3.5 - 5.2)	mmol/L *
Chlorid	105	106	108	98 *	113	(98 - 109)	mmol/L *
Bicarb.	20 *	18 *	19	24	23	(20 - 33)	mmol/L *
Urea	* 18.2 *	* 17.7 *	* 14.3 *	* 17.7 *	* 10.8	(3.0 - 10.0)	mmol/L *
Creat.	** 235 *	** 184 **	* 208 *	* 166 *	* 151	(40 - 85)	umol/L *
eGFR	18	23	20	28	31		mL/min/1.73m2
Urate	* 0.56	0.39	0.41	0.29	0.44	(0.15 - 0.45)	mmol/L *
Gluc.	* 8.8 *	12.2	5.9	5.7		(see below)	mmol/L *
Chol	5.5	5.7	5.7	5.7	5.1	(< 5.0)	mmol/L
Calc.	***1.34 **	** 1.69 *	* 1.94	2.11	2.21	(2.10 - 2.55)	mmol/L *
iCa	** 0.73 *	* 0.90 *	* 0.99			(1.07 - 1.27)	mmol/L
Phos.	1.38 *	* 1.85 *	* 1.59 *	* 0.64	1.08	(0.75 - 1.45)	mmol/L *

1.PLOC 65 66 71 61 60 (60 - 61) 9/L

F1-Prev Form | F2-Help | F4-Return | F5-Zoom | F10-More Key

----- Press Enter for further results -----

ELECTROLYTES

Renal impairment with associated hyperuricaemia. Significant hypocalcaemia. Recommend vitamin D check.

Note this level of calcium is too low to be due solely to the renal impairment.

eGFR < 30 indicates significant renal impairment.

Random glucose at this level may indicate increased risk for diabetes. A fasting glucose is suggested.

-- START OF PRIVATE COMMENTS --

Spoke to Nurse at angaston hospital she said they will try to contact the DR.

--- END OF PRIVATE COMMENTS ---

Phoned at 12:16 am on 07/10/2009 to 08 85648500 by Rachmat Abrahams.

Validated by Helen Martin

F6-Prv Field | F7-Clear | F8-Clear Rt | F9-Restore | F10-More Key  
[U]p, [D]own, [F]orward, [B]ackward, [N]ext\_report, [Q]uit

ELECTROLYTES

Renal impairment with associated hyperuricaemia. Significant hypocalcaemia. Recommend vitamin D check.

Note this level of calcium is too low to be due solely to the renal impairment.

eGFR < 30 indicates significant renal impairment.

Random glucose at this level may indicate increased risk for diabetes. A fasting glucose is suggested.

-- START OF PRIVATE COMMENTS --

Spoke to Nurse at angaston hospital she said they will try to contact the DR.

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Phoned at 12:16 am on 07/10/2009 to 08 85648500 by Rachmat Abrahams.

Validated by Helen Martin

PTH 106.6, vitamin D <20

F6-Prv Field | F7-Clear | F8-Clear R | F9-Restore | F10-More Key  
[U]p, [D]own, [F]orward, [B]ackward, [N]ext\_report, [Q]uit

# Vitamin D deficiency is very common

## SO WHAT?

- **Epidemiological studies suggest vitamin D insufficiency is related to**
  - **breast, prostate and colon cancer**
  - **Type 2 DM**
  - **CVD including hypertension**
    - **Causality established in hypertension through randomised intervention studies**

Mosekilde, Clin Endocrinol  
(Oxf). 2005; 62(3):265-281

# What happens if we don't have Vitamin D?

**Evidence from gene deletions in human and mouse models: deletion of VDR and/or CYP27B1 genes demonstrate disruption of:**

- **calcium and skeletal homeostasis**
  - Osteomalacia, osteoporosis
- **cellular development and differentiation** eg keratinocytes/ alopecia , apoptosis, angiogenesis
- **reproductive system in males and females**
- **immune system**
  - Infection
  - Auto-immune

## Populations at High Risk for Vitamin D Deficiency

- **Reduced sunlight exposure**
  - Age, infirmity, dress, habit
- **Reduced synthesis**
  - Skin thickness, dark pigment
- **Malabsorption/G.I. Dysfunction**
  - Coeliac, IBS, Crohn's, CF, pancreatitis, PBC
- **Reduced synthesis or enhanced degradation of 25-OHD**
  - Chronic liver disease.
  - Drugs



**Table. Sun exposure times that result in adequate vitamin D production without significant risk of skin damage for people with moderately fair skin\***

Location	December-January	July-August	
	At 10 am or 2 pm <sup>†</sup>	At 10 am or 2 pm	At 12 noon
<b>Australia</b>			
Cairns	6 to 7 minutes	9 to 12 minutes	7 minutes
Townsville	5 to 7 minutes	9 to 13 minutes	7 minutes
Brisbane	6 to 7 minutes	15 to 19 minutes	11 minutes
Perth	5 to 6 minutes	20 to 28 minutes	15 minutes
Sydney	6 to 8 minutes	26 to 28 minutes	16 minutes
Adelaide	5 to 7 minutes	25 to 38 minutes	19 minutes
Melbourne	6 to 8 minutes	32 to 52 minutes	25 minutes
Hobart	7 to 9 minutes	40 to 47 minutes	29 minutes
<b>New Zealand</b>			
Auckland	6 to 8 minutes	30 to 47 minutes	24 minutes
Christchurch	6 to 9 minutes	49 to 97 minutes	40 minutes

\* Exposure to achieve 1/3 minimal erythral dose (MED) is advised to be before 10 am or after 3 pm. Exposure times for people with highly pigmented skin are three to six times greater. <sup>†</sup> 11 am or 3 pm daylight saving time, respectively. Adapted from: Working Group of the Australian and New Zealand Bone and Mineral Society, Endocrine Society of Australia and Osteoporosis Australia. Vitamin D and adult bone health in Australia and New Zealand: a position statement. Med J Aust 2005; 182: 281-284.

# Vitamin D and the skeleton

- **33% of women 60 –70 yrs have osteoporosis.  
66% of >80yrs**
- **47% women, 22% men now 50 yrs will sustain osteoporotic # in remaining lifetime**
- **1200mg Ca, 800IU vit D daily for 3 yrs reduced hip # risk by 43% and non-vertebral # by 32%  
(Chapuy et al, NEJM: 1992)**
- **Osteoporosis accounts for 1 billion \$ direct costs (8.7 b \$ indirect costs) to Australian community per year (OA 2007)**

# Vitamin D and the skeleton

- **Admission every 5-6 minutes in Australia for an osteoporotic #**
- **25% of those who sustain a hip # die within 12 months**
  - **80% within 5 yrs**
- **50% need long term help**
- **25% require admission to a nursing home**
- **Vertebral # often undetected, but impose a 2x risk for hip fracture (Osteoporosis Australia, 2007)**
- **State working party: recommends 1 g Ca, 1000IU D3/day**

# 23 y.o F. c.o. tiredness

<b>Iron</b>	<b>2</b>	<b>(10-27 umol/L)</b>
<b>Tf</b>	<b>4.0</b>	<b>(1.5-3.0 g/L)</b>
<b>% Sat.</b>	<b>18</b>	<b>(15-45%)</b>
<b>Ferritin</b>	<b>5</b>	<b>(10-150ug/L)</b>
<b>Hb</b>	<b>52</b>	<b>(130-180 g/L)</b>
<b>MCV</b>	<b>57</b>	<b>(82-98 fl)</b>
<b>MCH</b>	<b>17</b>	<b>(27-52 pg)</b>
<b>RCC</b>	<b>3.1</b>	<b>(4.5-6.0 pl)</b>

# Iron Deficiency

- **Common**
  - 38% children in sw Sydney, 50% pregnant
- **Classic pattern easy to recognise**
  - Fe, %Sat, Ferr, Hb, MCV all decreased
  - Tf, sTfR increased
- **Note Biochemical parameters change first, then MCV, MCH then Hb**

# Symptoms of Iron Deficiency



**RUNNING OUT OF STEAM?**

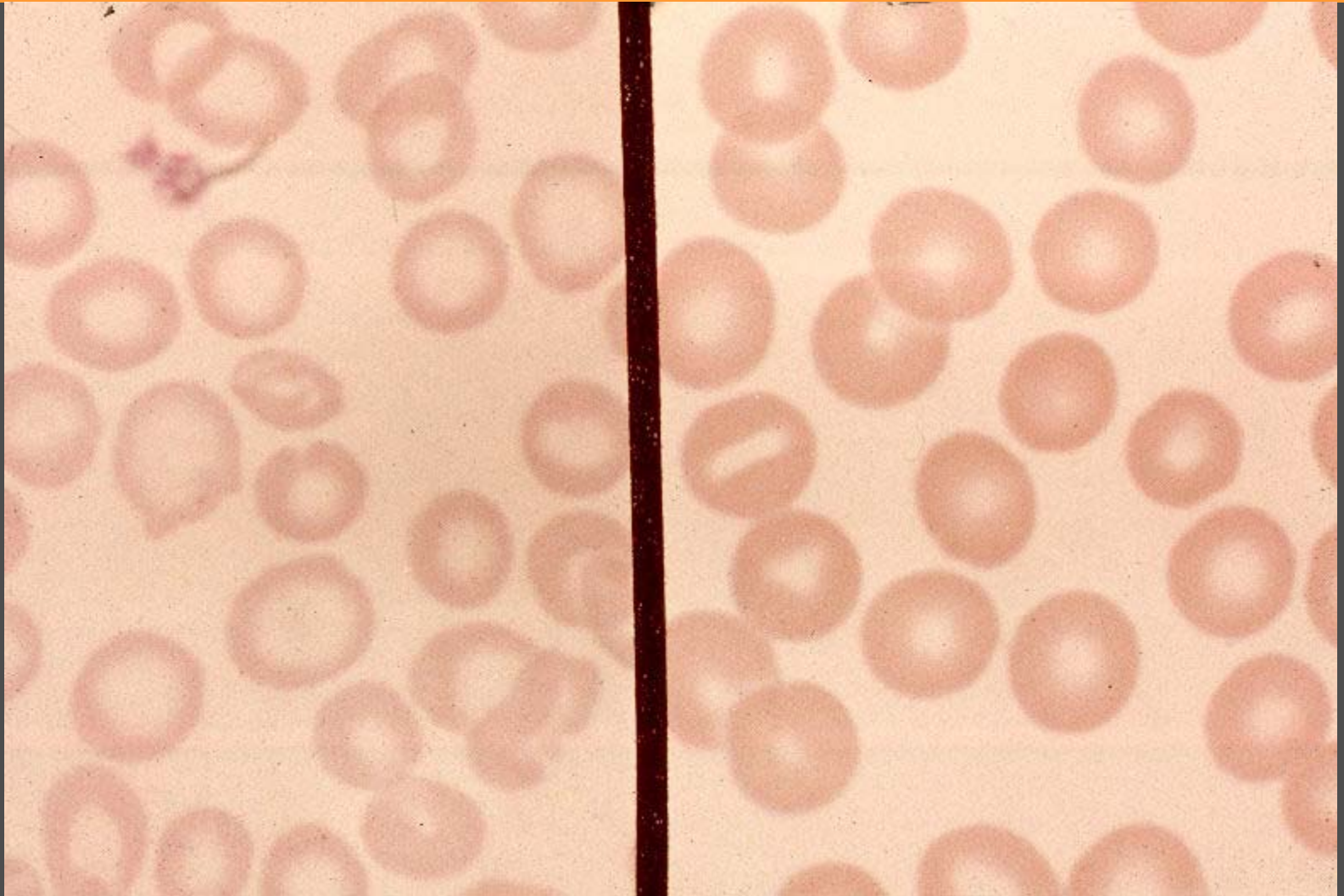
- Tired, extreme fatigue
- Pallor
- Lightheaded, SOB
- Headache
- Loss of appetite
- Hair loss, brittle spoon shaped nails, swollen sore tongue, cracks at mouthedge

# Severe Iron Deficiency

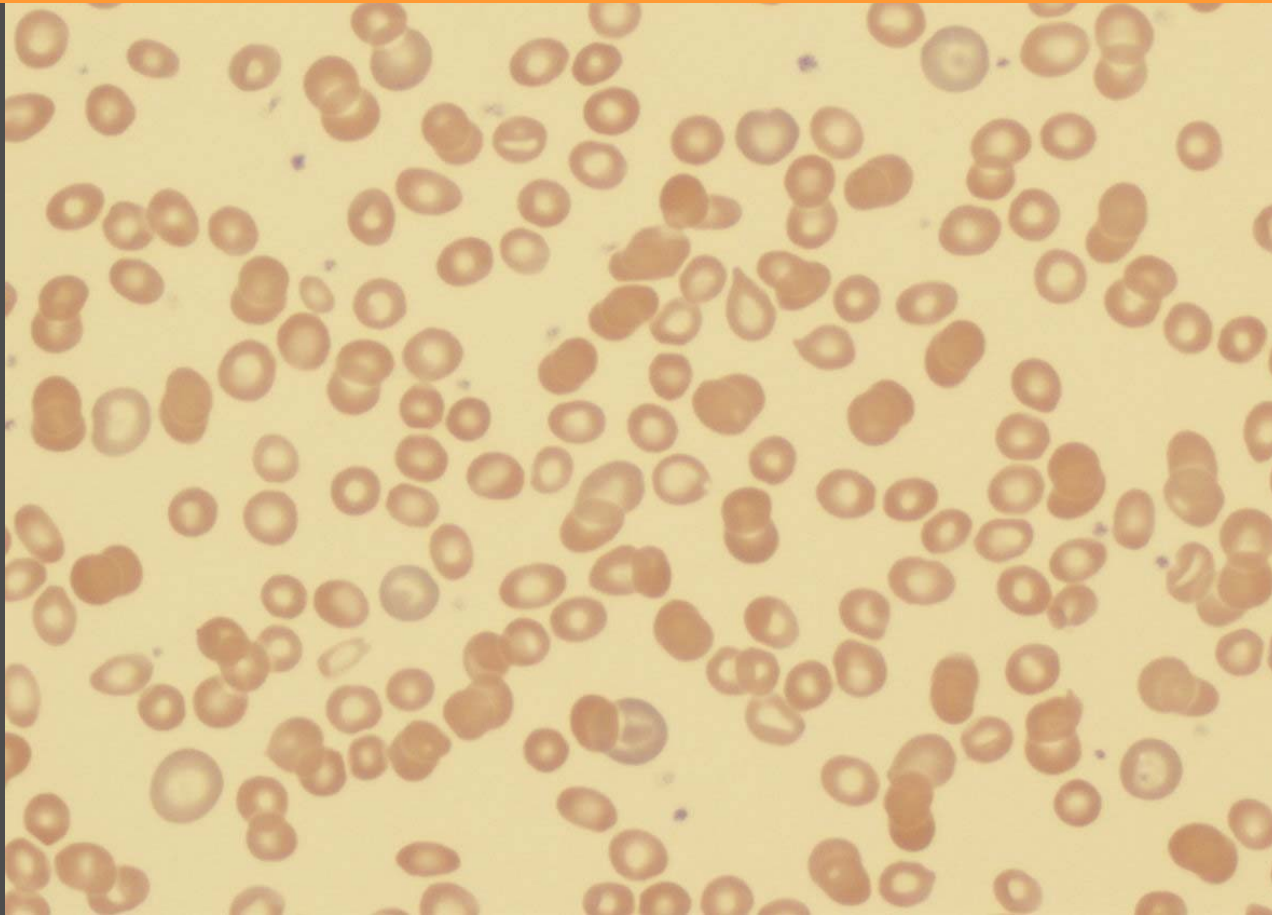


Iron Def.

Normal



# Partially Treated Iron Deficiency



# Iron Deficiency is Common !!



IRON  
DEFICIENT  
ROSE  
Photo  
courtesy of  
Ray Weil  
University  
of Maryland

**18 y.o F**

**c.o. tiredness**

Iron	13	(10-27 umol/L)
Tf	2.8	(1.5-3.0 g/L)
% Sat.	18	(15-45%)
Ferritin	68	(10-150ug/L)
Hb	105	(130-180 g/L)
MCV	59	(82-98 fl)
MCH	19	(27-52 pg)
RCC	5.6	(4.5-6.0 pl)

# Not Iron Deficient

- Haemoglobin electrophoresis
- Patient had increased HbA2 and HbF consistent with beta thalassaemia

# Beta Thalassaemia Trait

- In iron deficiency Hb concentrations tend to be relatively lower in relation to red cell size than in beta thalassaemia trait
- $( \{ \text{MCV} - [0.5 \times \text{Hb}] \} - \text{RBC} - 3.4 )$
- Positive ( $>1$ ) result suggests iron deficiency
- Negative ( $<1$ ) result is found in beta thalassaemia
- Applying the formula to this case gives a result of -2.5

**40 y.o M.**

**abnormal LFT's**

- Iron                      41                      (10-27 umol/L)
- Tf                            1.8                      (1.5-3.0 g/L)
- % Sat.                    91                        (15-45%)
- Ferritin                    4820                    (10-150ug/L)

**40 y.o M.**

**abnormal LFT's**

- Iron                      41                      (10-27 umol/L)
- Tf                            1.8                      (1.5-3.0 g/L)
- % Sat.                    91                        (15-45%)
- Ferritin                  4820                    (10-150ug/L)
  
- HFE gene test            homozygous C282Y

**40 y.o M.**

**abnormal LFT's**

- Iron 41 (10-27 umol/L)
- Tf 1.8 (1.5-3.0 g/L)
- % Sat. 91 (15-45%)
- Ferritin 4820 (10-150ug/L)
  
- Liver iron 760 (5-24 mmol/kg dry wt)
- Hepatic Index 16.9 (<2 mmol/kg/yr)
- Diagnosis HHC

# Iron overload

- **Secondary**
  - **Thalassaemia**
  - **Megaloblastic anaemia**
  - **Siderosis**
  - **Repeated transfusion**
  - **PCT**
  - **Alcoholic liver disease**
- **Primary**
  - **Hereditary haemochromatosis**

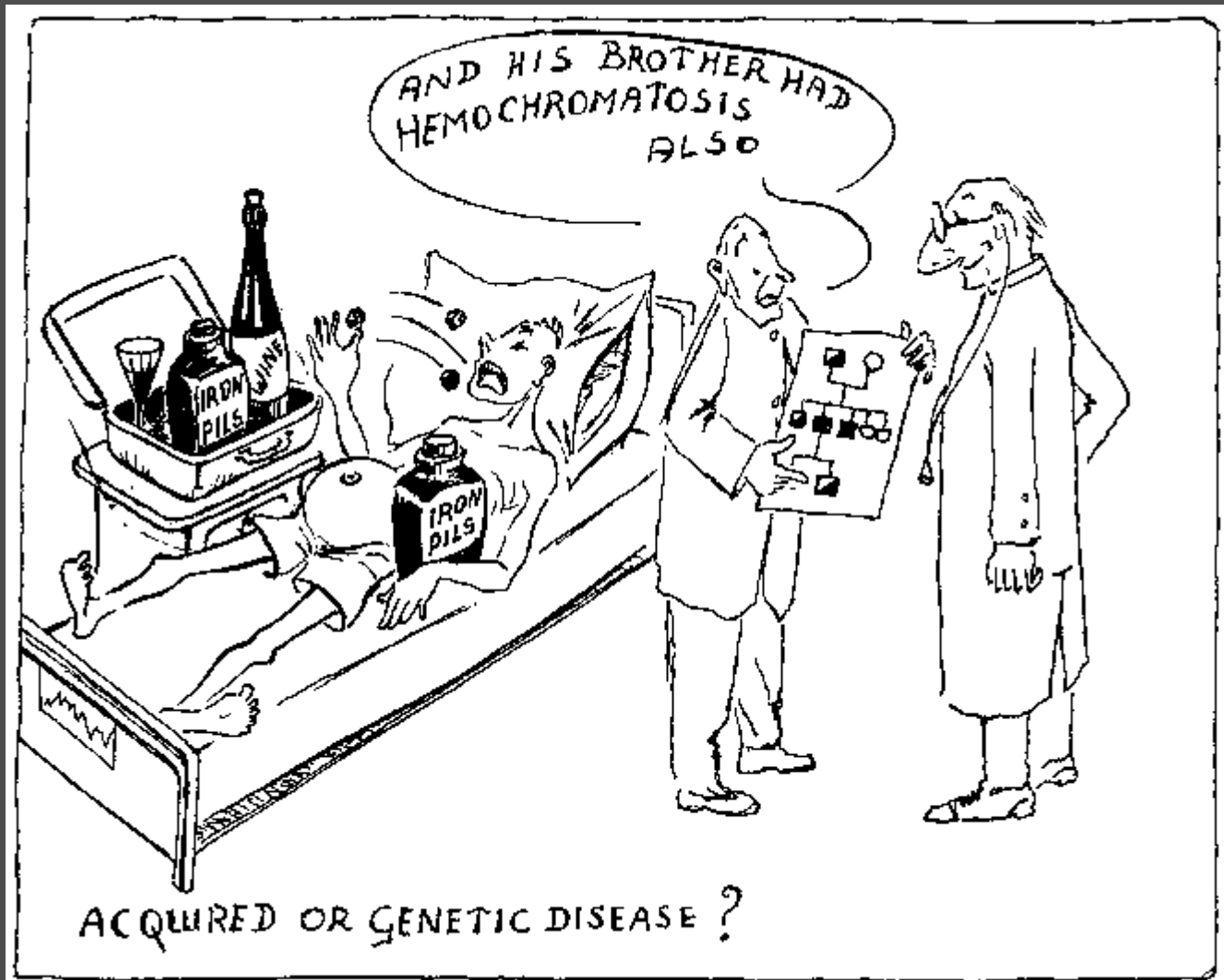


# Haemochromatosis (HHC)

- **Most common genetic disorder in Australia**
  - **Carrier 1/11**                      **Disorder 1/190**
- More common in males than females
- Clinical presentation 35-55 y.o “bronze diabetes”
- Liver dysfunction, cardiac arrhythmia's, hypo-gonadism, arthralgia, hypo-adrenalism

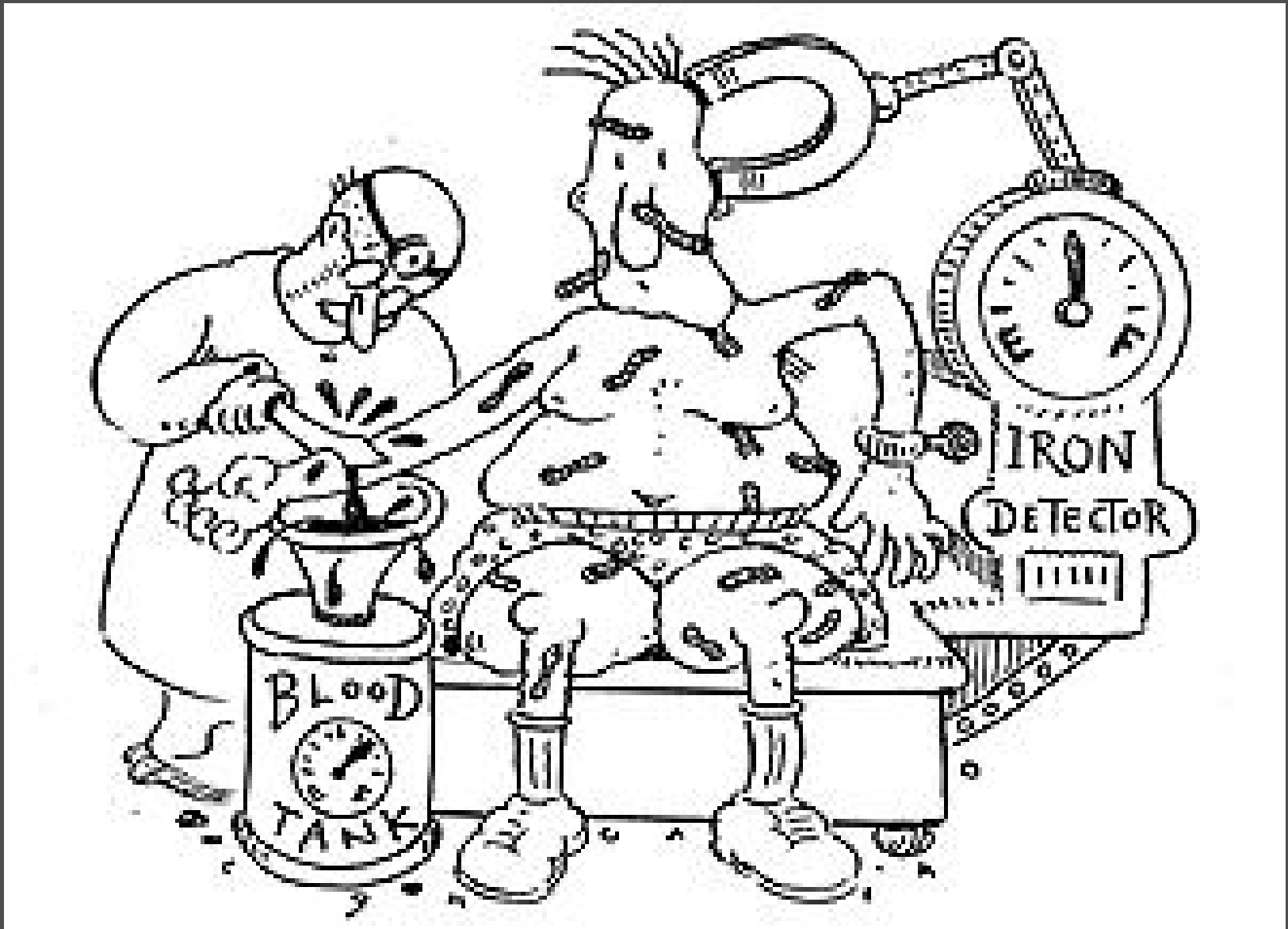
## HHC (2)

- **Association with HLA-A3 and HLA-B14**
- **HFE gene mapped in 1996 by Felder et al**
- **Mis-sense mutation Cys282Tyr**
  - **cause in 75-83% of HHC**
    - **routinely detected by PCR**
    - **phenotypic variation and incomplete penetrance**
    - **environmental effects**
    - **Medicare rebatable if screen positive, or proband is a first degree relative**



# HHC (3)

- **Screening**
  - **HC meets WHO criteria for population screening**
    - **common, morbid, long asymptomatic phase, effective treatment available**
    - **spin - off detection in relatives of proband**
  - **Transferrin saturation >55% gives 96% sensitivity and 94% specificity**



**31 y.o. F**

**pregnant**

- Iron 17 (10-27  $\mu\text{mol/L}$ )
- Tf 4.21 (1.5-3.0 g/L)
- % Sat. 16 (15-45%)
- Ferritin 13 (10-150  $\mu\text{g/L}$ )
- Hb 106 (130-180 g/L)
- MCV 88 (82-98 fl)
- MCH 32 (27-52 pg)
- RCC 3.6 (4.5-6.0 p1)

**39 y.o. F**

**c.o. tiredness**

- Iron 5 (10-27  $\mu\text{mol/L}$ )
- Tf 2.95 (1.5-3.0  $\text{g/L}$ )
- % Sat. 7 (15-45%)
- Ferritin 21 (10-150  $\mu\text{g/L}$ )
- Hb 118 (130-180  $\text{g/L}$ )
- MCV 87 (82-98  $\text{fl}$ )
- MCH 28 (27-52  $\text{pg}$ )
- RCC 4.2 (4.5-6.0  $\text{pl}$ )

**75 y.o. M**

**with RA**

- Iron 16 (10-27 umol/L)
- Tf 2.7 (1.5-3.0 g/L)
- % Sat. 24 (15-45%)
- Ferritin 55 (10-150ug/L)
- Hb 127 (130-180 g/L)
- MCV 87 (82-98 fl)
- MCH 28 (27-52 pg)
- RCC 4.2 (4.5-6.0 pl)

**55 y.o. M**

**with ....**

- Iron 35 (10-27 umol/L)
- Tf 1.6 (1.5-3.0 g/L)
- % Sat. 86 (15-45%)
- Ferritin 8 (10-150ug/L)
- Hb 171 (130-180 g/L)
- MCV 91 (82-98 fl)
- MCH 32 (27-52 pg)
- RCC 5.3 (4.5-6.0 pl)

# Result interpretation

- Clinical history is important
- Look for patterns
- Concentrate on most abnormal result
- Early diagnosis can improve quality of life and ultimate outcomes for patients.
- Laboratories play an important role in this process.
- Practise!!

F. 39 y.o. Pruritis

PHx gall bladder removed. Nil med.

<b>TP</b>	<b>67 g/L</b>	<b>55 – 80</b>
<b>Alb</b>	<b>41 g/L</b>	<b>33 - 50</b>
<b>TBil</b>	<b>80 umol/L</b>	<b>1 – 20*</b>
<b>cBil</b>	<b>45 umol/L</b>	<b>1 – 5*</b>
<b>ALP</b>	<b>909 U/L</b>	<b>35 – 115*</b>
<b>GGT</b>	<b>1444 U/L</b>	<b>0 – 30*</b>
<b>AST</b>	<b>128 U/L</b>	<b>0 – 45*</b>
<b>ALT</b>	<b>165 U/L</b>	<b>0 – 50*</b>
<b>LD</b>	<b>241 U/L</b>	<b>120 - 250</b>

# Cholestasis

- Predominant cholestasis: increases in ALP and GGT significantly exceed those of ALT and AST

This case:

- ALP ~9x normal
- GGT ~50x normal
- AST, ALT 2-3x normal
- Tbil mildly elevated

# Causes of Cholestasis

- **Drugs:** Erythromycin, Oestrogens, OC, L-dopa, Captopril, An. Steroids, statins
- **Extra-hepatic obstruction**
  - Stones, stricture, pancreatitis, malignancy
- **Intra-hepatic obstruction**
  - Pregnancy
  - Viral/alcoholic hepatitis, gram –ve bacteraemia
  - Auto-immune disease: PBC, PCS, CAH, PSC
  - NAFLD/NASH
  - Inflammation: Secondary Cholangitis
  - Genetic: Wilsons, AAT def, haemochromatosis, porphyria
  - Space occupying lesions: cysts, abcess, malignancy, granuloma

F. 39 y.o. Pruritis

PHx gall bladder removed. Nil med.

<b>TP</b>	<b>67 g/L</b>	<b>55 – 80</b>
<b>Alb</b>	<b>41 g/L</b>	<b>33 - 50</b>
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<b>LD</b>	<b>241 U/L</b>	<b>120 - 250</b>

# Primary Biliary Cirrhosis

- Uncommon “auto-immune” disorder
  - Raised IgM, positive auto-antibodies: AMA positive in >95% of cases, 98% specific
  - Incidence 2 cases / 100,000 in Victoria
  - Up to 90% female
  - 25% diagnosed with routine blood testing
  - Tx Ursodiol (bile acid) improves lab and clinical parameters.
  - No cure without liver transplant. Mean survival from Dx is 7.5 yrs if symptomatic and 16 yrs if not.

## M 21 y.o. neurological signs and splenomegaly

Na	141	135 – 144	TP	68	55 - 80
K	3.9	3.2 – 5.3	Alb	36	33 – 50
Cl	104	95 – 106	Tbil	22	1 – 20*
Bic	29	22 – 30	ALP	337	35 – 115 *
Urea	3.3	3.6 – 7.0	GGT	160	0 – 50*
Crt	100	50 – 120	AST	25	0 – 45
UA	130	150 – 500 *	ALT	28	0 – 45
			LD	213	120 – 250

# Causes of Cholestasis

- **Drugs:** Erythromycin, Oestrogens, OC, L-dopa, Captopril, An. Steroids, statins
- **Extra-hepatic obstruction**
  - Stones, stricture, pancreatitis, malignancy
- **Intra-hepatic obstruction**
  - Viral/alcoholic hepatitis, gram –ve bacteraemia
  - Auto-immune disease: PBC, PCS, CAH, PSC
  - NAFLD/NASH
  - Inflammation: Secondary Cholangitis
  - Genetic: Wilsons, AAT def, haemochromatosis, porphyria
  - Space occupying lesions: cysts, abcess, malignancy, granuloma

# M 21 y.o.

- Uneventful childhood
- 2 years ago had severe haematemesis requiring transfusion.
- 1 year ago developed involuntary movements – resolved
- 7 months ago he underwent a personality change and became so aggressive he was institutionalised - ? Anoxic brain damage due to prev haemorrhage
- 6 weeks ago he again developed involuntary movements which became steadily worse
- Sister died aged 11 yrs of cirrhosis

# Wilson's disease

- Inherited in an autosomal recessive manner
- Incidence in Australia 1 per 100,000
- Diagnosis peaks at 10-13 yrs by liver abnormalities or neuropsychiatric illness in young second or third decade.
- Abnormal accumulation of copper: deposition leads to organ damage, brain, liver, RBC, eyes. Mutation identified.
- Important to diagnose pre-symptoms. Always consider in persistent liver dysfunction and/or neurological disease in young subjects. Serum Cu/Caeruloplasmin ( $\downarrow$ ) Ucu ( $\uparrow$ )
- Treatable: galzin, penicillamine, trientine. Liver transplant

Thank you

