Osmolality is an indicator of hydration status, being elevated in patients who are volume depleted (dehydrated) and lowered in those patients who are over hydrated. It may, however, be elevated in the presence of hyperglycaemia. In the presence of an elevated serum osmolality the urine osmolality should increase as the body attempts to retain fluid. The opposite should occur in cases of reduced serum osmolality, where the normal body response would be to produce large volumes of dilute urine. Patients are said to exhibit the syndrome of inappropriate antidiuretic hormone (SIADH) when their serum osmolality is low (<280 mOsmol/kg) yet the urine is inappropriately concentrated (>300 mOsmol/kg).

Thyroid function tests

Free thyroxine (T_4) .....10–25 picomol/L

Free liothyronine (T_3) .....4.0–8.0 picomol/L

Thyroid stimulating hormone (TSH).....0.4–5.0 mIU/L

TSH is used as a screening test to evaluate thyroid function. T_3 test is used primarily to diagnose hyperthyroidism and amiodarone-induced thyrotoxicosis.[2,3] In patients with primary hyperthyroidism (e.g. Graves' disease) TSH levels are suppressed, whereas in those with primary hypothyroidism the TSH levels are elevated. In patients with secondary (pituitary dysfunction) and tertiary (hypothalamic dysfunction) hypothyroidism both T_4 and TSH levels are reduced.

Increased levels of thyroxine are found in hyperthyroidism, acute thyroiditis and hepatitis. Low levels of thyroxine can be found in cretinism, hypothyroidism, cirrhosis, malnutrition and chronic thyroiditis. T_4 and TSH are used when monitoring therapy. Values of T_4 up to 35 picomol/L may be acceptable for patients receiving full replacement therapy with thyroxine. Low TSH levels may represent over-replacement with thyroxine. In patients with acute non-thyroid illness thyroid function test may be difficult to interpret. Up to 70% of such patients admitted to hospital develop 'euthyroid sick syndrome' with low thyroxine levels and elevated TSH. This usually resolves without the need for treatment.

Urea

..... 3.0–8.0 mmol/L

Urea is the end product of protein metabolism. Therefore serum urea concentrations are influenced by both the rate of protein breakdown and the protein's renal excretion. Increases can be caused by excessive protein intake, kidney damage, certain drugs, dehydration, gastrointestinal bleeding, excessive sweating during exercise and heart failure. Decreased levels may be associated with malnutrition, malabsorption, liver damage and low nitrogen intake. A high serum urea to serum creatinine ratio may indicate prerenal failure (secondary to volume depletion or decreased cardiac output) or gastrointestinal haemorrhage. Alternatively, a low urea to creatinine ratio may indicate liver dysfunction or excessive muscle breakdown (rhabdomyolysis) (see Table D.3).

Uric acid (urate)

Female ..... 0.15–0.40 mmol/L

Male ..... 0.20–0.45 mmol/L

Catabolism of purines results in the formation of uric acid, which is normally excreted in the urine. Elevated uric acid levels (hyperuricaemia) are noted in gout, infections, kidney disease, alcoholism, high-protein diets, in association with tumour lysis syndrome and with toxaemia in pregnancy. Low levels may be indicative of Fanconi's syndrome, pregnancy, Wilson's disease, drug effects, malabsorption, poor diet or liver damage.

Plasma proteins

Albumin

.....32–45 g/L (varies with age)

Albumin, the main constituent of serum protein (usually over 50%), is synthesised in the liver. Hypoalbuminaemia may result from:

- increased albumin loss (nephrotic syndrome, burns, Crohn's disease)
- increased catabolism (infection, trauma, thyrotoxicosis)
- decreased synthesis (chronic hepatitis, severe acute hepatitis, malnutrition).

Clinical effects become particularly apparent when the serum albumin falls below 30 g/L; such effects include peripheral oedema, ascites and pulmonary oedema.[13] Protein binding of drugs such as phenytoin and warfarin is reduced.

Hyperalbuminaemia is seen rarely in liver disease, shock, dehydration or multiple myeloma.

C-reactive protein

..... <5 mg/L

C-reactive protein (CRP) is an acute-phase reactant produced by the liver in response to cytokine release during inflammation. Levels rise and fall more quickly than ESR (erythrocyte sedimentation rate). CRP has been used in clinical practice to follow systemic inflammation (especially bacterial infection, systemic lupus erythematosus, and rheumatoid arthritis). Basal levels of CRP, in the absence of apparent inflammatory disease, may be useful for predicting myocardial or