

Unit 4: Laboratory Data Interpretation II

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4.1 Tests associated with cardiac disorders

The cardiac panel supports the diagnosis of heart muscle injury, the assessment of heart failure and the monitoring of cardiac risk and therapy, and its modern centre is the cardiac troponin measurement. Troponins are proteins of the heart muscle contractile apparatus released into the blood when myocardial cells are injured, and a rising and falling pattern of troponin, with at least one value above the laboratory's decision limit, in a patient with symptoms or signs of ischaemia, is the laboratory core of the diagnosis of myocardial infarction; the same measurement rises in other myocardial injury, including myocarditis and severe cardiac strain, so troponin is read against the clinical picture and its trend over serial samples. The older cardiac enzymes, creatine kinase and its MB fraction and the historical enzyme panels, are taught for the record, with troponin understood as the more cardiac specific and sensitive successor. The natriuretic peptides, brain natriuretic peptide and its N terminal fragment, are released by the stretched heart wall and are used in the assessment of heart failure: a low value in a breathless patient argues strongly against heart failure as the cause, a high value supports it and carries prognostic weight, and the trend follows the response to therapy, with renal impairment and age among the cautions. The lipid profile, total cholesterol with its lipoprotein fractions and triglycerides, belongs to cardiac risk assessment and to the monitoring of lipid lowering therapy rather than to acute diagnosis. Cardiac monitoring data complete the picture beside the laboratory panel: the electrocardiogram for rhythm, ischaemia and the conduction effects of medicines, and blood pressure and heart rate trends.

4.2 Pulmonary function tests

Pulmonary function tests measure how the lungs move air and, in the fuller laboratory, how they exchange gas, and the pharmacist interprets them chiefly to classify ventilatory defects and to follow respiratory disease and its therapy. Spirometry is the core test: the recorded volumes and flows include the forced vital capacity, the total volume forcibly exhaled after a full inspiration, and the forced expiratory volume in one second, the volume expelled in the first second of that manoeuvre, with their ratio as the interpretive key. The standard patterns should be stated plainly. In obstructive disease, of which asthma and chronic obstructive pulmonary disease are the teaching examples, air leaves slowly, the one second volume falls disproportionately and the ratio falls. In restrictive disease, where the lungs or chest wall cannot expand, volumes fall together and the ratio is preserved or raised. Reversibility testing, repeating spirometry after an inhaled bronchodilator, separates the reversible obstruction of asthma from the largely fixed obstruction of chronic disease and measures response to the very class of medicines the pharmacist counsels on. Peak expiratory flow measurement is the simpler portable form, used for asthma monitoring by patients themselves, read as personal best comparisons and diurnal variation rather than as a single number. Lung volumes, gas transfer measurements and arterial blood gas analysis for oxygen, carbon dioxide and acid base state complete the panel: blood gases decide the severity of respiratory failure and the safety of oxygen therapy, and connect this section to Section 4.4.

4.3 Thyroid function tests

Thyroid function tests interpret the pituitary thyroid axis as a system, and the panel is the clearest example in this subject of a result that cannot be read one analyte at a time. The thyroid gland secretes principally

thyroxine, with the more active triiodothyronine, under the drive of pituitary thyroid stimulating hormone, and the axis is governed by negative feedback: when circulating thyroid hormone falls, the pituitary hormone rises to drive the gland, and when hormone rises, the pituitary signal is suppressed. The standard panel is therefore the thyroid stimulating hormone together with free thyroxine, with free triiodothyronine and thyroid antibodies in defined situations. The patterns follow the feedback logic. A raised thyroid stimulating hormone with a low free thyroxine is primary hypothyroidism, the gland failing and the pituitary calling louder. A suppressed hormone with raised free thyroxine, with or without raised triiodothyronine, is primary hyperthyroidism, the gland overproducing and the pituitary silenced. A raised pituitary hormone with a normal free thyroxine is subclinical hypothyroidism, and the mirror image is subclinical hyperthyroidism, both being monitoring categories as much as treatment categories. Antibodies assist in establishing autoimmune causes of failure and overactivity.

4.4 Fluid and electrolyte balance

Fluid and electrolyte balance is the physiology that keeps the body's water compartments and its dissolved ions within the narrow ranges cell function requires, and its disturbances are among the commonest ward laboratory problems and among the most frequently drug related. The accounting frame is standard: water is distributed between the intracellular and the extracellular compartments, the extracellular including the plasma, and balance means intake, from drink, food and metabolism, matches output, through urine, gut, skin and breathing, under control in which the kidney, antidiuretic hormone and the renin angiotensin aldosterone system do most of the adjusting. The electrolytes are interpreted individually and together. Sodium is the principal extracellular ion and its concentration reports water balance relative to sodium rather than total body sodium: a low sodium directs attention to water excess, sodium loss and the medicines, diuretics prominent among them, that produce both, while a high sodium reports water deficit, and both extremes disturb brain function first. Potassium is the principal intracellular ion, and its plasma concentration governs cardiac and muscle excitability: low potassium, classically from diuretic therapy, vomiting and diarrhoea, raises the toxicity of several cardiac medicines and disturbs rhythm, and high potassium, from renal failure, tissue breakdown and potassium retaining medicines, is among the most urgent abnormalities in laboratory medicine. Calcium, magnesium and phosphate complete the taught panel: calcium, disturbed by parathyroid, vitamin D, bone and renal disorders and by medicines; magnesium, frequently low alongside potassium and sharing its causes; and phosphate, bound up with renal function and bone. Acid base balance is read with the electrolytes: pH with bicarbonate and carbon dioxide separates metabolic from respiratory disturbance, and the anion gap sorts the metabolic acidoses by their likely family of cause.

4.5 Microbiological culture and sensitivity tests

Microbiological culture and sensitivity testing is the laboratory system that identifies the organism causing an infection and measures which antimicrobial agents inhibit or kill it, and it is the evidential basis on which rational antimicrobial therapy, and its review by the pharmacist, stands. The process runs in defined stages. A specimen is collected from the site of infection, blood, urine, sputum, wound material, cerebrospinal fluid or another site, before antimicrobial therapy where possible, in the correct container and transported promptly, because a badly taken specimen grows the flora of the skin or the delay rather than the cause of the disease. In the laboratory the specimen is examined directly, by microscopy including the Gram stain, which gives an early broad classification, and is cultured on media from which colonies of the infecting organism are isolated and identified. Sensitivity testing then exposes the organism to a panel of agents, by disc diffusion, in which zones of inhibited growth around agent containing discs are measured and interpreted, or by dilution methods that determine the minimum inhibitory concentration, the lowest concentration that inhibits growth. Results are reported in standard categories: susceptible, where the

agent at achievable concentrations is expected to succeed; intermediate, where success is uncertain or depends on concentration at the site; and resistant, where a mechanism defeats the agent at safe concentrations. The pharmacist's interpretive work is a defined clinical skill: matching the report to the therapy, so empirical treatment started before results is narrowed to the effective agent the report supports and changed where resistance is shown; reading sensitivity with the site of infection, since an agent must reach the site as well as inhibit the organism; distinguishing contamination and colonisation from true infection, with the clinical team, before a report triggers treatment the patient does not need; and using the institution's accumulated sensitivity patterns to inform empirical choices and formulary decisions.

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