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Comprehensive Physiological, Hematological, Biochemical, Immunological and Molecular Diagnostic Investigations

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1. Introduction

Diagnostic investigations integrate physiological assessment with laboratory evaluation to identify disease, assess organ function, monitor therapy and predict outcomes.

2. Physiological Diagnostic Investigations

- Cardiovascular: ECG, Holter, BP, echocardiography, cardiac output, stress testing, pulse oximetry.
- Respiratory: spirometry, lung volumes, capnography, blood gases, diffusion capacity.
- Nervous: EEG, EMG, nerve conduction, evoked potentials, reflexes.

- Renal: GFR, creatinine clearance, urine concentration, renal blood flow.
- Gastrointestinal: motility, gastric acid, pH, absorption tests.
- Endocrine & metabolic: glucose tolerance, ACTH stimulation, dexamethasone suppression, TRH/GnRH tests, basal metabolic rate.
- Reproductive: semen evaluation, estrous monitoring, fertility testing, pregnancy diagnosis.
- Musculoskeletal: gait analysis, muscle strength, bone mineral density.

3. Hematological Investigations

CBP, hemoglobin, PCV, RBC, WBC, platelet count, differential leukocyte count, erythrocyte indices (MCV, MCH,

MCHC), reticulocyte count, ESR, blood smear, coagulation profile (PT, aPTT, thrombin time, fibrinogen, D-dimer).

4. Clinical Biochemical Investigations

Carbohydrate: glucose, HbA1c, fructosamine, lactate.

Liver: ALT, AST, ALP, GGT, SDH, GLDH, bilirubin, albumin, total protein.

Kidney: urea, creatinine, SDMA, cystatin-C, uric acid.

Lipid profile: cholesterol, HDL, LDL, VLDL, triglycerides.

Electrolytes: Na, K, Cl, Ca, Mg, P, HCO₃.

Cardiac biomarkers: Troponin I/T, CK-MB, BNP.

Muscle: CK, LDH, myoglobin.

Pancreas: amylase, lipase, pancreatic lipase immunoreactivity.

Oxidative stress: MDA, SOD, catalase, glutathione peroxidase, TAC.

5. Endocrine Investigations

Thyroid (T₃, T₄, FT₄, TSH); Adrenal (cortisol, ACTH, Aldosterone, Renin); pancreatic (insulin, C-peptide, glucagon); pituitary (GH, IGF-1, prolactin, FSH, LH); gonadal (testosterone, estrogen, progesterone, AMH); calcium regulation (PTH, calcitonin, vitamin D).

6. Immunological Investigations

ELISA, immunofluorescence, AGID, Western blot, immunohistochemistry, flow cytometry, cytokine assays, complement assays, immunoglobulin estimation,

autoantibody assays, interferon-gamma release assays, neutralization tests.

7. Molecular Biological Investigations

Conventional PCR, RT-PCR, real-time PCR, multiplex PCR, nested PCR, digital PCR; Sanger sequencing, NGS, WGS, WES; Southern/Northern/Western blotting, FISH, microarrays; RT-qPCR, RNA sequencing; SNP analysis, microsatellites, DNA fingerprinting; CRISPR diagnostics (SHERLOCK, DETECTR); genomics, transcriptomics, proteomics, metabolomics, lipidomics and glycomics.

8. Biomarkers

Cardiac, inflammatory, renal, hepatic, neurological, reproductive, tumor and oxidative stress biomarkers for early diagnosis and monitoring.

9. Techniques and Instrumentation

Spectrophotometry, chromatography, electrophoresis, immunoassays, molecular diagnostics, mass spectrometry, biosensors, flow cytometry and automated analyzers.

10. Clinical Significance

Diagnosis, prognosis, screening, monitoring treatment, herd health surveillance, preventive medicine and precision medicine.

11. Future Perspectives

Artificial intelligence, digital pathology, wearable biosensors, point-of-care diagnostics, telemedicine and

personalized medicine will further enhance diagnostic accuracy.

12. Conclusion

Integration of physiological, hematological, biochemical, immunological and molecular diagnostic investigations enables comprehensive assessment of health and disease, supporting accurate diagnosis and evidence-based clinical decision-making.

References

Please contact the corresponding author.