Analysis of Body Fluids

Dr Maduri Vidanapathirana
MBBS, Dip Chem Path, MD Chemical Pathology, FRCPath(UK)
Senior Lecturer/Consultant Chemical Pathologist
Visiting Lecturer University of Ruhuna

Learning Outcomes

- What are the body fluids sent for biochemical analysis?
- What are the different types of urine samples and the tests they are used for?
- What is the clinical utility of cerebrospinal fluid (CSF)?
- What is the clinical utility of analyzing pleural/peritoneal/synovial fluid?

Body Fluids Used in Clinical Practice

- Urine
- Cerebrospinal fluid
- Synovial fluid
- Peritoneal/pleural fluid
- Saliva
- Seminal fluid
- Sweat

Types of Urine Samples for Biochemical Analysis

- Early morning mid stream
- Random/ spot
- Timed collections (24 hours)

- Composition and concentration of urine changes during 24 hours
- Urine concentration vary according: to **water intake** and **physical activities**

Tests Performed on Early Morning Urine

- Urine full report
- Urine albumin/creatinine ratio
- Urine protein/creatinine ratio

Urine Examination

Physical Examination

Colour
Clarity
Odour
Reaction (pH)
Specific gravity

Microscopic Examination

Centrifuged sediment
Red cells
Pus cells
Epithelial cells
Casts
Crystals
Organisms

Chemical Examination (manual tests/urine strips)

Proteins
Glucose and other reducing substances
Ketone bodies
Urobilinogen
Bilirubin

Urine Full Report (UFR)

Colour
Clarity
Specific gravity
pH
Protein
Sugar
Ketone bodies
Conjugate bilirubin
Urobilinogen

Centrifuged deposit

Pus cells
Red cells
Epithelial cells
Casts
Crystals
Organisms

- What is the clinical utility of UFR?

Random/Spot Samples

- Urine pH
- Urine osmolality
- Urine electrolytes
  - Potassium
  - Sodium
  - Chloride
- Pregnancy test
- Protein electrophoresis

Timed Collections

- Creatinine clearance (to measure GFR)
  - –True measure of GFR
- 24 hour urinary protein
  - –Nephrotic syndrome
- Vanillyl-Mandelic Acid (VMA)
- Urinary free metanephrines
  - –Phaechromocytoma
- Urinary free cortisol
  - –Cushing syndrome
- Calcium and phosphate

Principles of Sample Collection for Urine

- Early morning mid-stream: to sterile containers except for UFR
- Send to lab without delay
- Spot samples for pH, electrolytes: simultaneous collection of blood samples for comparison
- Timed collections: container with preservative from the lab
- Store in a cool place during collection

Indications for CSF Collection

- Diagnosis of meningitis and encephalitis
- Subarachnoid haemorrhage (SAH)
  - Presenting >12 hours later
- Demyelinating diseases (multiple sclerosis)
- Meningeal involvement in malignant disorders

What are the contraindications for lumbar puncture?

- Suspicion of a mass lesion in the brain or cord. Caudal herniation of the cerebellar tonsils (coning) may occur if an intracranial mass is present and the pressure below is reduced by removal of CSF.
- Any cause of raised intracranial pressure
- Local infection near the lumbar puncture site
- Congenital lesions in the lumbosacral region (e.g meningomyelocele)
- Platelet count < 40 x 10^9/L and other clotting abnormalities, including anticoagulant drugs.

- Unconscious patients and those with papilloedema must have a CT scan before lumbar puncture.

Normal CSF

Normal CSF	
Appearance	Crystal clear, colourless
Pressure	60 - 150 mm of CSF, recumbent
Cell count	< 5/mm3 No polymorphs Mononuclear cells only
Protein	0.2 – 0.4 g/L
Glucose	2/3 – 1/2 of blood glucose
IgG	< 15% of total CSF protein
Oligoclonal bands	Absent

Subarachnoid Haemorrhage

- CT scan is the diagnostic test within the first 12 hours.
- Bilirubin is present in late presenters
- Spectrophotometric examination of CSF for bilirubin and oxyhaemoglobin are useful in late presenters
- Compared with serum bilirubin levels

Meningitis

- Three consecutive CSF samples
  - 1: biochemical analysis (glucose & protein)
  - 2. Gram stain, Culture and ABST
  - 3. Microscopy for cell counts

- Use sterile containers for all samples

- 1-2 mL is sufficient for each tube

CSF Findings in Infections

	Normal	Viral	Pyogenic	Tuberculosis
Appearance	Crystal clear	Clear/Turbid	Turbid/Purulent	Turbid/Viscous
Mono nuclear cells	<5/mm^3	10-100/mm^3	<50/mm^3	100-300/mm^3
Polymorph cells	Nil	Nil*	200-300/mm^3	0-200/mm^3
Proteins	0.2-0.4g/L	0.4-0.8 g/L	0.5-2.0 g/L	0.5-3.0 g/L
Glucose	2/3-1/2 blood glucose	>1/2 blood glucose	<1/2 blood glucose	<1/2 blood glucose

Pleural Fluid

- To differentiate transudate from exudate
  - –Protein
  - –Lactate dehydrogenase (LDH)
- Values compared with that of serum
- Gram stain/ Ziehl- Neelsen stain & culture
- Adenosine deaminase increases in Tuberculosis
- Cytology for malignant cells

Light’s criteria

- To differentiate an exudate from transudate in pleural fluid
- Pleural fluid is an exudate if one or more of the following are met
  - Pleural fluid protein: serum protein is > 0.5
  - Pleural fluid LDH: serum LDH > 0.6
  - Pleural fluid LDH > 2/3 of upper reference limit for serum LDH

Common causes of pleural effusions

Exudate	Transudate
Parapneumonic effusions	Left ventricular failure
Malignancy	Cirrhosis

References

- The biochemistry of body fluids. Association of Clinical Biochemists in Ireland scientific committee guidelines. Oct 2009.

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