



# ThinPrep<sup>®</sup> General Cytology Lecture Series

Cerebrospinal Fluid Cytology

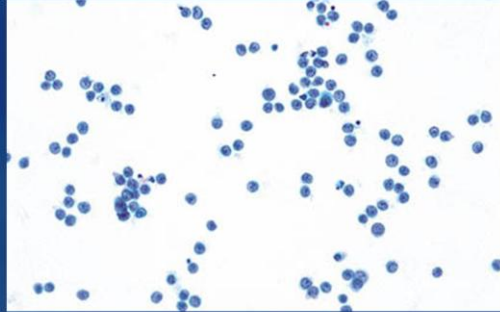
# Benefits of ThinPrep Technology

The use of ThinPrep<sup>®</sup> General Cytology for cerebrospinal fluid specimens aids in:

- Controlling cell recovery
- Reducing obscuring elements
- Retaining background clues
- Preventing protein precipitation



# Cerebrospinal Fluid



*ThinPrep*  
General Cytology I

# Anatomy

- Subarachnoid space
  - The space that surrounds the brain and spinal cord
  - Contains approximately 80-100 ml of cerebrospinal fluid (CSF)
  - Lined internally by the pia mater and externally by the arachnoid membrane



The subarachnoid space contains the cerebrospinal fluid. Unlike serous cavities, this space normally contains a volume of fluid that can be as much as 150 ml.

## Biological Nature of CSF

- Created mainly by filtration of plasma through the choroid plexus
- Low specific gravity
- Contains proteins, inorganic salts and dextrose
- Is normally acellular



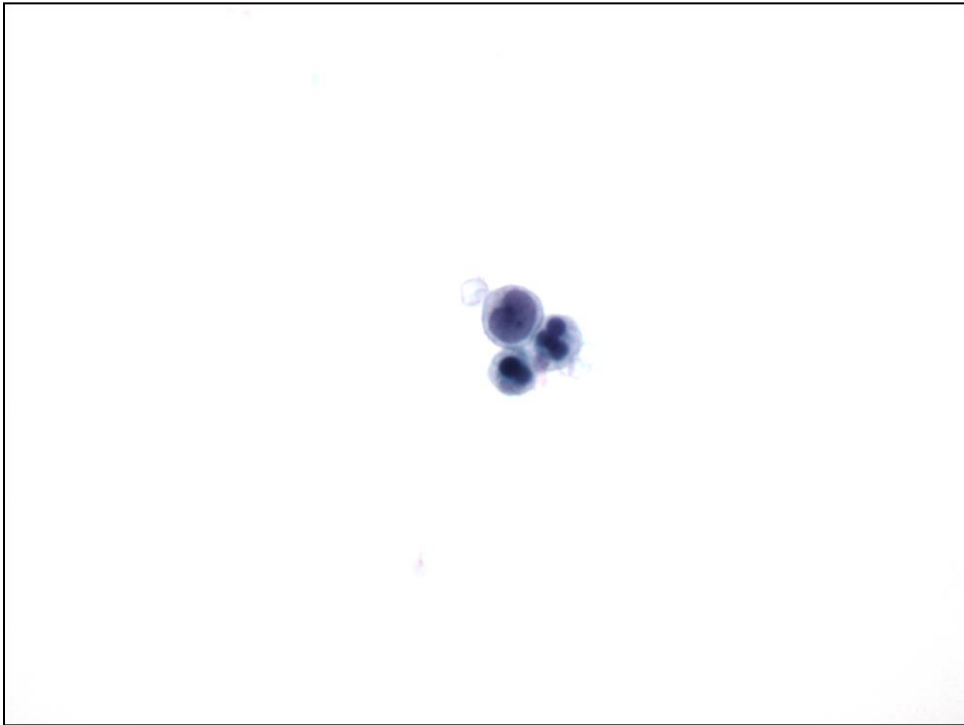
CSF is formed mainly in the ventricles from blood filtered through the choroid plexus. The specific gravity ranges from about 1.004-1.008 and is slightly viscous. Normally, cells are very scant to absent when collected by LP(lumbar puncture). Ventricular fluid specimens, however, are usually much more cellular.

# Normal Components and Findings

- Lumbar puncture
  - May appear more cellular with ThinPrep due to better cell retrieval
  - Rare lymphocytes, monocytes and PMN's
  - Cells from surrounding tissue
    - Ependymal cells
    - Arachnoidal cells
    - Choroid plexus cells



This is a list of what can be found in the CSF. Normally, there are fewer than 5 to 10 cells per cubic mm. If present, ependymal cells will be small columnar or cuboidal cells. Arachnoidal cells may be in cohesive clusters and resemble mesothelial cells. Cuboidal cells from the choroid plexus may appear in groups and are characterized by small, hyperchromatic round nuclei.



Normal CSF at 40X. Very scanty cellular with rare RBC's, PMN's and a monocyte.

## Normal Components and Findings

- Ventricular fluid
  - Abundant choroid plexus cells
  - Neurons
  - Capillaries
  - May see multinucleated giant cells



This is a list of the component that may be found in the ventricular fluid. These are often collected via shunt or needle. Multinucleated giant cells may be seen in patients with a shunt.



# Normal Components and Findings

- Contaminants
  - Cellular
    - Squamous cells
    - Chondrocytes
    - Red blood cells
  - Non-cellular
    - Talc



Contaminants, both cellular and otherwise are often seen in CSF specimens. Squamous cells, cartilage, muscle and RBC's can all be introduced into the fluid during collection. Megakaryocytes may be seen in instances when a vertebral body is accidentally nicked.

## Benign Entities

- Causes of nonmalignant meningitis/encephalitis
  - Bacterial
  - Viral
  - Fungal



Bacterial, viral or fungal infection is the most common cause of infectious meningitis. Other rare causes may include parasitic infection, systemic disease, multiple sclerosis or endometriosis.

# Cytology of Benign Entities



- Acute inflammatory process
  - Bacterial
    - Predominance of PMN's
  - Viral
    - Predominance of active lymphocytes
  - Fungal
    - Cellular pattern may depend on immune status of patient
    - May be mixed inflammatory cell infiltrate

Bacterial infection may be caused by TB, pneumococcus, or other organisms and is characterized by an inflamed CSF with a low glucose and elevated protein content.

Infection caused by such viruses as CMV or Herpes will present in the CSF as a very active lymphocytic infiltrate. Typically, glucose is unchanged and protein is slightly elevated.

Fungal meningitis can be caused by cryptococcus, aspergillus, candida or other fungi. Cellular reaction to these organisms is rare in immunosuppressed individuals but may be present in those with healthy immune systems.

The specific infectious agent may be identified.

# Cytology of Benign Entities

- Chronic inflammatory process
  - Lymphocytes typically predominate in most chronic infections
  - Monocytes
  - Histiocytes



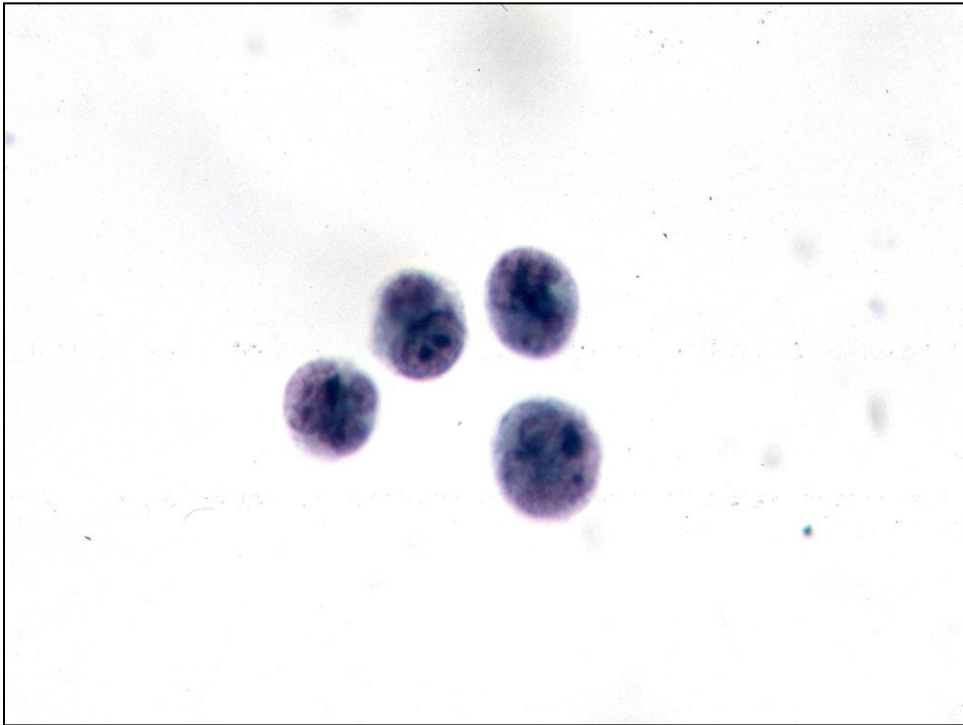
Lymphocytes are typically present in the chronic phase of infection. They may be accompanied by histiocytes, monocytes and/or plasmacytoid cells.

# Primary Malignant Disease

- Leukemia
  - Leukemic cells are larger than normal lymphocytes
  - Nuclei are irregular and three dimensional
  - Mitotic figures can be seen
  - Nucleoli may be prominent



Acute lymphoblastic leukemia (ALL) and undifferentiated stem cell leukemia are the most common types of primary leukemia found in CSF.



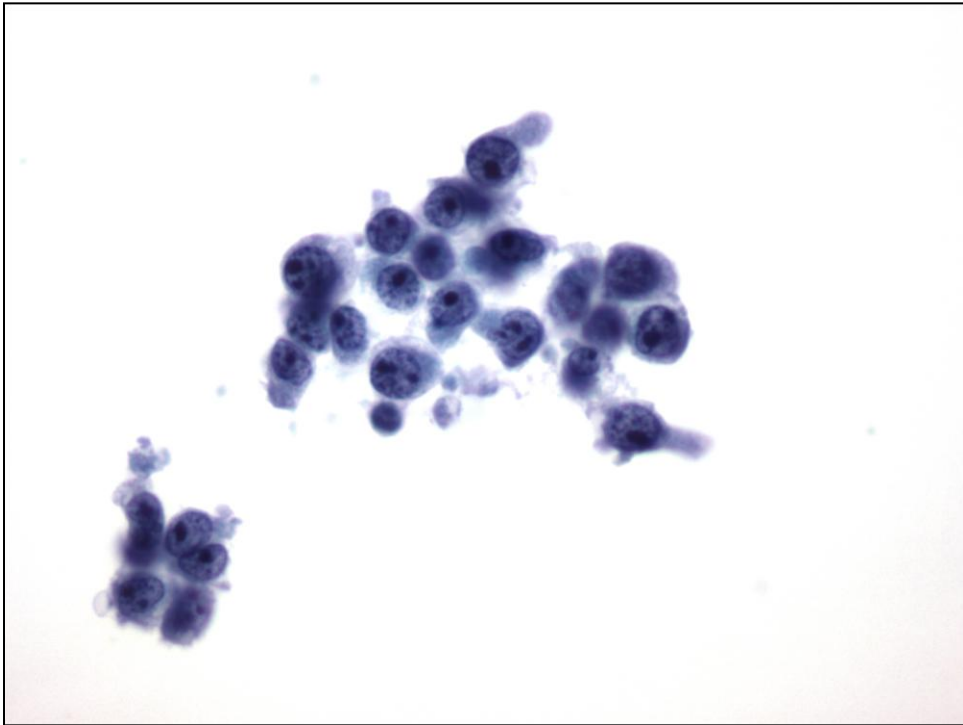
ALL in CSF at 60X. Note irregular nuclei in relatively small round cells. Population is singly dispersed.

# Primary Malignant Disease

- Lymphoma
  - Singly distributed usually monomorphic population of cells with high N:C ratio
  - Nuclei are irregular with clumpy chromatin
  - Macronucleoli may be present
  - Mitotic activity may be evident



Primary lymphoma most commonly present is high grade Non-Hodgkin's type, including large cell, immunoblastic, lymphoblastic, Burkitt's and undifferentiated.



Lymphoma in CSF at 40X. Cells are loosely clustered and have coarse chromatin and prominent nucleoli. All cells resemble each other very closely.

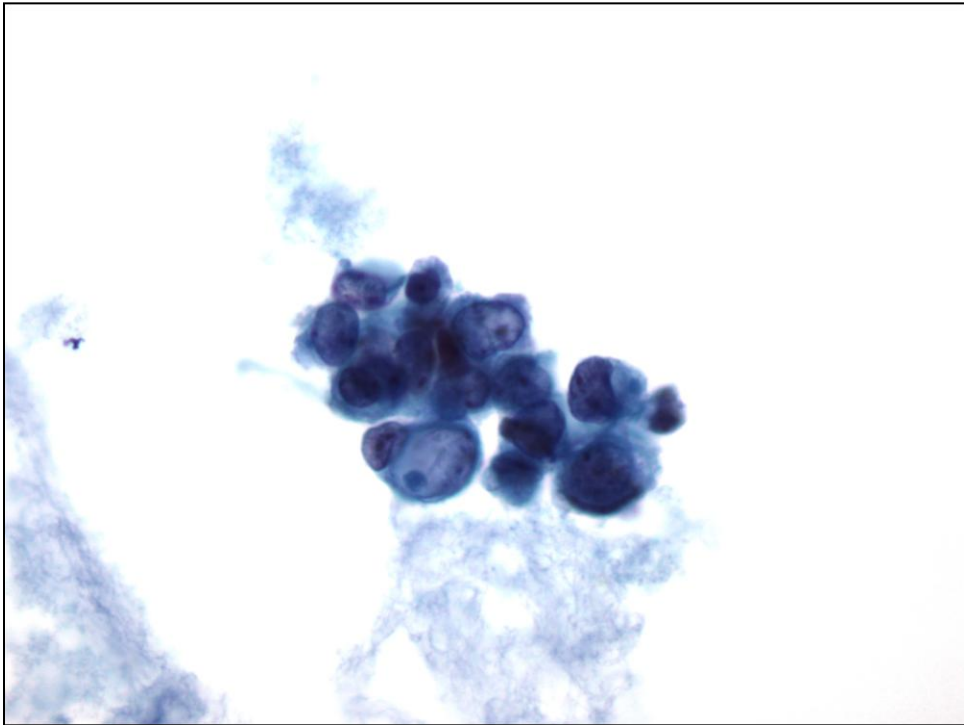


# Metastatic Malignant Disease

- Adenocarcinoma
  - Cells often present singly or in small clusters
  - Nuclei are irregular, three dimensional and eccentrically located
  - Nucleoli are often present
  - There may be cytoplasmic vacuolization



The most common types that metastasize to CSF are lung, breast and gastric adenocarcinoma.



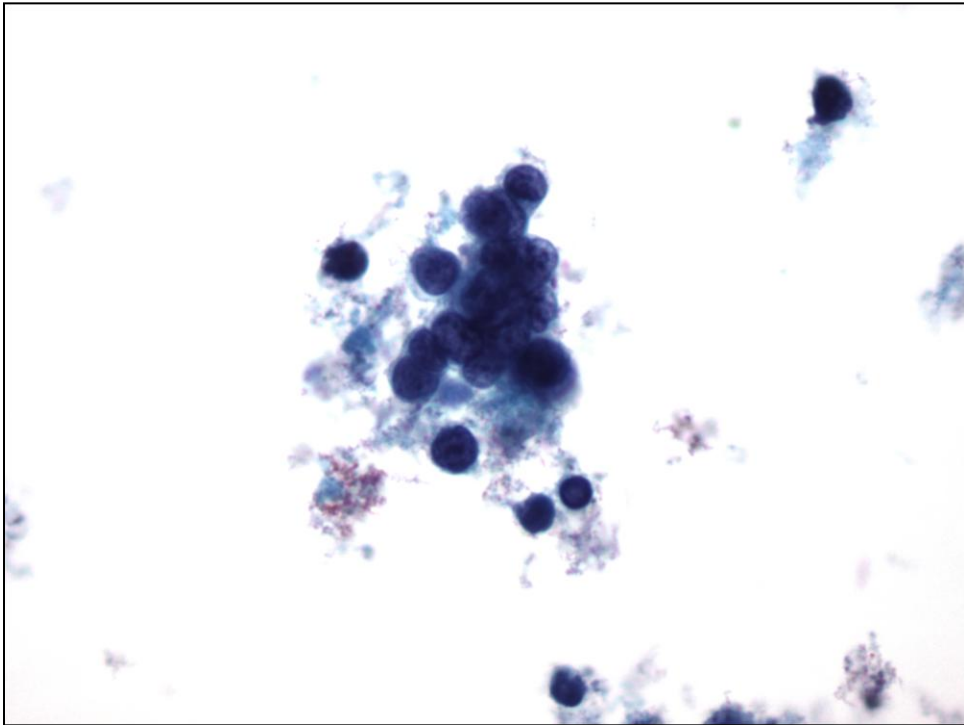
Metastatic breast adenocarcinoma in CSF at 40x. Note mucin-laden cells at 7:00 position.

# Metastatic Malignant Disease

- Small cell carcinoma
  - Cells are present in small, molded groups
  - Nuclei exhibit classic salt and pepper chromatin pattern and may be angular
  - Cells have only a scant rim of fragile cytoplasm



Small cell most commonly metastasizes from the lung.



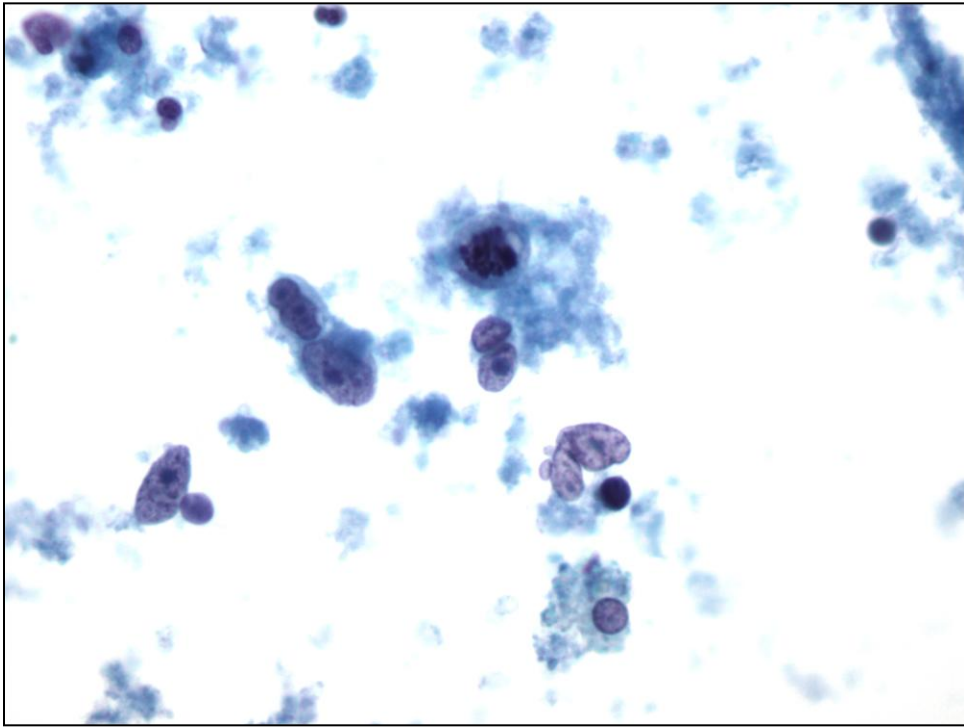
Small cell carcinoma in CSF at 40X. Note nuclear molding and salt and pepper chromatin.

# Metastatic Malignant Disease

- Malignant melanoma
  - Cells are usually singly distributed with occasional loose clusters
  - Nuclei are round to oval, centrally or eccentrically located and may be multiple
  - Nuclear chromatin is vesicular with eosinophilic macronucleoli
  - Coarse brown melanin granules may be present within the cytoplasm



Occasionally, melanoma may present with a more spindled appearance or may be comprised of small, hyperchromatic cells in cohesive groups. There may be intranuclear inclusions.



Melanoma in CSF at 40x.

## For more information...

- Refer to your ThinPrep 2000 Operator's Manual



## For more information...

- Visit our website [www.cytyc.com](http://www.cytyc.com),  
[www.thinprep.com](http://www.thinprep.com) or  
[www.cervicalscreening.com](http://www.cervicalscreening.com)
  - Product Catalog
  - Contact Information
  - Complete Gynecologic and Non-gynecologic Bibliographies
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## Bibliography

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