FNA of Enlarged Cervical Lymph Nodes

- Indications:
  - Lymph nodes larger than 1-2 cm generally cause for concern in adults — FNA!
    » Children and young adults – benign lymphadenopathy more common; higher threshold for performing FNA
  - FNA used to:
    » Confirm reactive hyperplasia
    » Diagnose suspected infection
    » Diagnose suspected malignancy
    » Hodgkin, NHL, metastasis
    » Monitor for transformation to higher grade lymphoma

Dispersed Cell Population & Lymphoglandular Bodies:
Features of lymphoid aspirates
FNA of Enlarged Cervical Lymph Nodes

Technical Considerations:
- Material for ancillary studies for lymphomas:
  - Flow cytometry
  - RPMI or saline
  - Generally superior to CB/IHC for lymphomas
  - Cell block for IHC
  - FISH
  - Karyotypic analysis
  - Molecular genetics
- For metastasis:
  - Cell block for IHC
- For infections:
  - Material for microbiologic studies

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FNA of Enlarged Cervical Lymph Nodes: Metastatic Disease

Most common metastatic tumors in HN:
- Squamous cell carcinoma (HPV+/-)
- Thyroid carcinoma (PTC, MTC, UTC)
- Malignant melanoma
- Nasopharyngeal carcinoma
- Neuroendocrine carcinoma (small cell, MDNC, Merkel cell)
- Distant metastases:
  - Lung
  - Breast
  - Kidney
  - Ovary
  - Pancreas
  - Germ cell tumors
  - Sarcomas

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FNA of Enlarged Cervical Lymph Nodes: Metastatic Disease

- High sensitivity and specificity for detection of LN mets
- Tumor cells are usually abundant relative to lymphoid tissue
- Majority of patients have history of cancer
  - Clinical correlation is essential
- Approx 20-30% are unknown primaries
  - Comparison with known carcinoma histology
  - Cell block for IHC
Met Squamous Cell Carcinoma
- Most common metastatic disease in HN
- For CUP, consider testing for HR-HPV
  - Usually level II-III
  - Usually non-keratinizing
- Ker 5/6, p63, p40+
- May be cystic with numerous histiocytes

Keratinizing SCC

Cystic SCC

Met Nasopharyngeal Carcinoma
- Usually non-keratinizing
- Undifferentiated-appearing
- Can be confused with lymphoma
- Ker 5/6, p63, p40+, EBER+

Metastatic PTC
- Often Cystic—pitfall
  - Cyst fluid Thyroglob
- Ker +, TTF-1+, PAX-8+, thyroglobulin+
Metastatic MTC
- Frequently presents as LN met
- Often bland cytology
- Ker+, Calcitonin+, Chromo+, TTF-1+

Spindled MTC
- Dispersed bland cells

Metastatic UTC
- Frequently involves LNs
- Undifferentiated
- May be keratin negative
- Ker+, PAX-8+, p53+, TTF-1, thyroglobulin

Spindled UTC
- High grade undiff cells

Metastatic Melanoma
- Great Masquerader
- Less than 50% have melanin
- Binucleation and nuclear inclusions
- Can mimic DLBCL
- S-100+, MART-1+, HMB-45+, Mitf+, Melan-A+, Ker+, CD45-

Pigmented MM
- Often plasmacytoid
Met Neuroendocrine Carcinoma
- Moderately diff NEC
- Merkel cell carcinoma
- Small cell carcinoma
- Ker+, Chromo/Synapt/NSE+

Merkel cell – Ker 20+
SimCC – Ker 20−

MDNEC – calcitonin+

Reactive Lymphoid Hyperplasia: Non-Specific
- Non-specific etiology
  - Children & young adults
  - Single enlarged LN
  - May obviate need for open excisional biopsy
  - Usually follicular rather than paracortical hyperplasia
- Cytology:
  » Wide variety of cell types
  » Cellular
  » Predominance of small lymphocytes
- Immunophenotype:
  » Polyclonal

Cytology of Reactive Lymphoid Hyperplasia

Cytologic findings – Variety of cell types:
- Dispersed polymorphous lymphoid population
- Small lymphocytes (B and T cells) predominate
- Plasmaacytoid lymphocytes
- Centrocytes
- Centroblasts
- Immunoblasts
- Histiocyte/macrophages
- Dendritic cells
- Dendritic-lymphocytic aggregates (“intact follicles”)
- Eosinophils
- Mast cells
Reactive LN: Mixed Lymphoid Population

Predominance of small lymphocytes (Mixed B & T cells)

Reactive LN: Germinal Center Fragments

(aka: Lymphohistiocytic aggregates)

Do not confuse these cohesive groups with metastatic disease!

Reactive LN: Tingible Body Macrophage
Reactive Lymphoid Hyperplasia:

Notes and Cautions:
• Clinical information is critical
• Caution for diagnosing reactive LN hyperplasia in:
  – Elderly
  – LN >3cm
  – Multiple enlarged LNs
  – Deep seated LNs
• No LN architecture in FNA
  – Rely on heterogeneity of cell pattern & polyclonality
  – Some lymphomas can also have a heterogenous pattern
    – Hodgkin lymphoma
    – Follicular lymphoma
    – Marginal zone lymphoma
    – Post-transplant lymphoproliferative disorder
    – Some T-cell lymphomas
    – T-cell rich B-cell lymphoma

Reactive Process VS Lymphoma

• IMMUNOPHENOTYPING combined with cytomorphology is the key to distinguishing NHL vs reactive LN hyperplasia.

Pitfalls:
• The presence of a mixed population of small lymphocytes does not exclude lymphoma
• The presence of tingible body macrophages does not exclude lymphoma
• Negative flow cytometry & atypical cytology:
  Importace of microscopic evaluation:
  – Some DLBCL
  – Hodgkin lymphoma
  – T-cell rich B-cell lymphoma
  – Peripheral T-cell lymphomas
FNA of Enlarged Cervical Lymph Nodes

- Sensitivity of FNA for NHL > 80%

A note in negative LN cases is sometimes useful:
- Clinical correlation is recommended to ensure that the specimen is representative of the suspected lesion. If clinical suspicion persists, consider repeat tissue sampling.

Specific Causes of Reactive LNs Not Easily Diagnosed by FNA

- Generally cannot be definitively distinguished from reactive lymphoid hyperplasia by FNA
- Associated with characteristic architectural features by histology:
  - Castleman disease
  - Toxoplasma lymphadenitis
  - Progressive transformation of germinal centers

Other Specific Causes of Reactive LNs Diagnosed or Suggested by FNA

Can often be diagnosed or suggested by FNA:
- Sarcoïdosis
- Bacterial and fungal lymphadenitis
- Cat scratch disease
- Mycobacterial lymphadenitis
- Rosai Dorfman disease
- Kikuchi lymphadenitis
- Infectious mononucleosis
- Dermatopathic lymphadenitis
Sarcoidosis

- Systemic granulomatous disease
- Young to middle age adults
- More common in African Americans
- Diagnosis of exclusion/clinical correlation

Cytologic features:
- Non-caseating granulomas
- Epithelioid histiocytes
- Multinucleated giant cells
- Lymphocytes
- Clean background
- Hypocellular aspirate in late phase

DDX:
- Fungal or mycobacterial infection
- Malignancy-associated granulomas
- Foreign body reaction

Bacterial and Fungal Lymphadenitis

- Submit material for cultures
- Acute bacterial lymphadenitis
  - Cellular
  - Abundant neutrophils (pus)
- Fungal lymphadenitis
  - Variable cytology: Neutrophils/ granulomas/
    - Special stains: Silver, PAS, Mucicarmine
  - Most common: Cryptococcus, Coccidioides,
    Histoplasma

Cat Scratch Disease

- Self-limited; resolves in 1-4 months
- LNs of groin, axilla, neck
- Bartonella henselae (serologies/Steiner stain)
- Cat bite or scratch reported in 50-70%
- Cytology (suppurative granulomatous
  lymphadenitis)
  - Acute inflammation
  - Granuloma
  - Necrosis
Rosai Dorfman Disease

- Epstein-Barr virus (EBV)
- Adolescents
- Bilateral cervical lymphadenopathy
- Fever, joint pain, night sweats
- Labs: Polyclonal hypergammaglobulinemia; leukocytosis
- Cytology:
  - Predominance of small lymphs
  - Many large histiocytes with emperipolesis
- Ddx: lymphoma, LCH

Mononucleosis

- Etiology: EBV
- Adolescents and young adults
- Fever, malaise, pharyngitis, “tender” cervical lymphadenopathy, splenomegaly
- Atypical lymphocytosis, positive heterophile test, reversed CD4/CD8
- Cytology:
  - Increased immunoblasts, centroblasts, plasmacytoid lymphs, and plasma cells
  - Caution: Rare binucleated immunoblasts can resemble Reed Sternberg cells
  - DDX: Reactive lymphoid hyperplasia, CMV/Herpes/Drug hypersensitivity, large cell lymphoma, Hodgkin lymphoma
- CLINICAL CORRELATION!!!!!!
- Polyclonal; immunoblasts are CD15-

Diagnosing Lymphomas by FNA: How far can you go?
Diagnosing Lymphomas by FNA: How far can you go?

- Close consultation with your lab’s hematopathologist!
- How far do you need to go???
  - Definitive dx of many lymphomas is possible given adequate tissue for ancillary studies
  - Depends upon the quantity and quality of specimen
    - Flow, smears, cell block- IHC/molecular, cytogenetics
  - Well accepted for diagnosing recurrent lymphoma
  - Many institutions require open LN biopsy & histopath dx prior to beginning treatment of NEW lymphoma dx

Diagnosing Lymphomas by FNA: How far can you go?

- 2008 WHO classification of hematological malignancies places less emphasis on architectural patterns
- An algorithmic approach to morphology, immunophenotype, genetic features, and clinical findings
- Increases the role of FNA for diagnosis of lymphomas!

Some Basic Ancillary Lymphoid Markers

- CD3 - T cells
- CD4 - T cells, expresses in some T-cell lymphomas, small lymphocytic lymphoma and mantle cell lymphoma
- CD8 - T cells
- CD50 - T cells
- CD103 - Follicular lymphoma
- CD10 - Follicular lymphoma
- CD5 - T cells, coexpressed in some B-cell lymphoma, small lymphocytic lymphoma and mantle cell lymphoma
- CD20 - B cells
- CD19 - B cells
- CD10 - Follicular lymphoma
- Bcl-6 - Follicular center cells/follicular lymphoma
- CD23 - Small lymphocytic lymphoma (negative in mantle cell lymphoma)
- PAX5/BSAP - B cells (recurrent/rituximab treated patients)
- CD45 - Most lymphoid cells
- κ - B-cell immunoglobulin light chain (assessing clonality)
- λ - B-cell immunoglobulin light chain (assessing clonality)
- cyclin D1 - Mantle cell lymphoma
- Ki67 - Proliferative rate (for grading)
- CD15 - Reed-Sternberg cells (except nodular lymphocyte predominant Hodgkin lymphoma)
- CD30 - Reed-Sternberg cells, anaplastic large cell lymphoma
- Anaplastic lymphoma kinase - Anaplastic large cell lymphoma
- MUM1 - Non-germinal center B cell lymphomas; plasmacytic differentiation
Hodgkin Lymphoma

- Represents 30% of all lymphomas
- Bimodal distribution—peak 15-30 years
- Classical HL (95%) — 4 subtypes (no clinical relevance)
  - Nodular sclerosis
  - Lymphocyte rich
  - Mixed cellularity
  - Lymphocyte depleted
- Nodular lymphocyte predominant HL (rare)

FNA of Classical Hodgkin Lymphoma

- Large RS cells and mononuclear variants
  - CD30+ (non-specific), CD15+ (weak), PAX5+, CD20+/-, CD45-
- Background non-neoplastic small lymphocytes, eosinophils, plasma cells, fibroblasts, histiocytes
- Note: Presence of many background eosinophils may be a clue to HL
FNA of Classical Hodgkin Lymphoma: RS Cells

Pitfall: A cause of a false negative FNA is the Nodular Sclerosis Type of Classical HL due scant cellularity — Search carefully for RS cells!

- Mononuclear RS
- Binucleate RS

FNA of Classical Hodgkin Lymphoma

- CD30+ RS Cells

FNA DDX of Hodgkin Lymphoma

- Reactive lymphoid hyperplasia
- Infectious mononucleosis
- T-cell-rich large B-cell lymphoma
- Anaplastic large cell lymphoma
- Nasopharyngeal carcinoma
FNA of NLPHL Hodgkin Lymphoma

- Male, 30-50 years old
- Multisite lymphadenopathy
- Spares mediastinum
- Difficult to dx by FNA
- L&H cells – monoclonal B cells
  - Multilobate nucleus (popcorn cells)
  - CD20+, CD45+, CD30–, CD15–
  - May be indistinguishable from T-cell rich B-cell lymphoma
- Flow often shows CD4+/CD8+ T-cells which is a clue

Non-Hodgkin Lymphomas

- Divided into B- and T-cell types
  - B-cell NH lymphomas represent 90%
    - DLBCL and follicular lymphoma represent >75%
  - T-cell NH lymphomas represent approx 10%
    - Null cell lymphomas are rare
- Useful to divide into small and large cell lymphomas for FNA dx

Diagnosing NH Lymphomas by FNA

- Lymphomas with a characteristic immunophenotype include:
  - Small lymphocytic lymphoma: CD5+, CD23+, CD10–
  - Mantle cell lymphoma: CD5+, CD23–, CD10–
  - Lymphoblastic lymphoma: CD10+, Tdt+
Diagnosing NH Lymphomas by FNA

- How do we distinguish the different “small cell lymphomas”?

Subclassification of the 4 Major Small Cell NH Lymphomas: An Algorithmic Approach by Immunoprofile

- CD5 coexpression: B-CLL/SLL vs. Mantle cell
  - Light chain dim favors B-CLL/SLL
  - CD5+CD23+ = B-CLL/SLL
  - CD5+CD23- = Mantle cell

- CD5 negative: MALT vs. Follicular
  - CD10+ = Follicular lymphoma
  - CD10- unresolved (may require an open biopsy)
  - Can use IHC on cell block for CD10 and Bcl-6
  - Cytoplasmic Ig = MALT
  - CD43+ favors MALT
  - Bcl-6+ favors follicular lymphoma
  - Clinical: extranodal favors MALT; nodal favors follicular lymphoma

Follicular Lymphoma

- Clinical features:
  - 35% of adult NHL (USA)
  - Varies: often disseminated disease
  - 25-35% transformation to DLBCL
  - Indolent, rarely curable

- Cytologic features:
  - Pred. small irregular cleaved lymphoid cells
  - Large lymphoid aggregates
  - Few tingible body macrophages
  - Lymphoid cell aggregates
  - No standard FNA method for grading 1-3
  - Generally <40% centroblasts in low grade FL

- IHC and Molecular:
  - CD5-, CD10+, Bcl-6+ is characteristic
  - 40% CD10- overlap with MZL
  - T(14;18) in 99% of cases, detectable by FISH

- DDX:
  - Other small cell lymphomas for low grade
  - DLBCL (not distinguishable from gr 3 FL)
  - Necrotic and/or extranodal involvement
**Marginal Zone Lymphoma**

- Clinical features:
  - Low-grade, indolent, ultra-stage I or II; potential cure by surgery/chemotherapy
  - Nodal and extranodal (MALT) types
  - Salivary gland
  - MALT types assoc. with Hashimoto and Sjogren syndromes
  - Salivary gland, lacrimal gland, lung, thyroid, breast, skin
- Cytologic features:
  - Monocytoid cells, plasma cells
  - Follicular dendritic cells, tingible body macrophages, reactive immunoblasts, follicular aggregates
  - Lymphoepithelial lesions (MALT)
- IHC and Molecular:
  - CD5+, CD10-, Bcl-6-, cyclin D1-
  - Trisomy 3 or 18, t(11;18), others
- DDX:
  - Reactive lymphoid hyperplasia
  - CD10- Low grade follicular lymphoma

**Small Lymphocytic Lymphoma**

- Clinical features:
  - AKA: CLL
  - Indolent, incurable NHL in older adults
  - 60% of NHL
  - Widespread disease at presentation
  - 20% transformation to DLBCL (or Hodgkin)
- Main reason to follow by FNA
- Cytologic features:
  - Monomorphous small lymphocytes
  - Round nuclei with clumped chromatin
  - Smudged cells on smears
  - Absent nucleoli
  - Occ. prolymphocytes and paraimmunoblasts
  - Rare/TBM and follicular aggregates
- IHC and Molecular:
  - CD5+, CD23+, CD10-
  - CD5, CD20, LC are usually dim or weak
  - Trisomy 12 (30%), others
- DDX:
  - Transformation to DLBCL
  - Proportion of large cells and necrosis
  - Ki-67 >30% suggests transformation

**Mantle Cell Lymphoma**

- Clinical features:
  - Aggressive B-cell lymphoma/poor prognosis
  - 3-5 yr median survival
  - 30% of NHL; adults; 90% M:F
  - Commonly extranodal
- Cytologic features:
  - Monomorphous small to intermediate lymphs
  - Fine chromatin
  - Indistinct nucleoli
  - Scant cytoplasm
  - Absent centroblasts and immunoblasts
  - Lymphoid aggregates
  - Dermal infiltrates with “pink” cytoplasm
- IHC and Molecular:
  - CD5+, CD10-, CD23- cyclin D1+, CD43+, Bcl-6-
  - T(11;14) usually present — overexpression of cyclin D1
  - IHC and/or FISH useful to confirm dx
- DDX:
  - Other small cell lymphomas

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Diagnosing NH Lymphomas by FNA

How do we distinguish the different “large cell” lymphomas?
- Broad heterogeneous category from B cells, T cells, or NK cells.
- Dominated by DLBCL
- Many occur in children:
  - DLBCL, lymphoblastic lymphoma, Burkitt lymphoma

Subclassification of Large Cell NH Lymphomas

- CD19/20+ = B-cell lymphoma
- sIg+ = Mature B-cell lymphoma (large B-cell vs. Burkitt’s...may require open biopsy)
  - CD10+ = favors Burkitt’s (c-myc translocation)
  - CD10- = favors large B-cell lymphoma (most common diagnosis; follicular pattern often not important)
- DLBCL Subtypes include: centroblastic, immunoblastic, T-cell rich, and anaplastic, primary mediastinal, double hit lymphoma, primary effusion lymphoma, germinal center-like, activated B-cell-like
- sIg- = Mature B-cell vs. B-lymphoblastic
- CD10+Tdt+ = Precursor B-lymphoblastic
- CD10-Tdt- = Large B-cell lymphoma
- CD19/20-, CD55+ = T-cell lymphoma
- Tdt+ = Precursor T-lymphoblastic
- Tdt- = Peripheral T-cell lymphoma (may need open biopsy to subclassify)

Diffuse Large B-Cell Lymphoma

- Clinical features:
  - 35% of adult NHL (USA)
  - Multiple subtypes
  - Aggressive but potentially curable
- Cytologic features:
  - Pred. large cells (2.5-5 x size of small lymph)
  - Dense to large nucleoli
  - Scant to absent dendritic-lymphocytic aggregates
- IHC and Molecular:
  - Can be difficult to detect by flow
    - CD20+, PAX5+ to confirm B-cell
    - BCL-2 rearrangement in 90%
    - BCL-6 abnormalities 3q27 in 30%
  - All cases should have CD10, BCL-6, and BCL-2
  - Other parameters: cyclin D1, Akt, and MUM1
    - High-grade lymphoma, cyclin D1 message may help distinguish from non-GC type
    - DLX:
      - Other large cell lymphomas
        - Grade II

- Diffuse Large B-Cell Lymphoma
Double-Hit Lymphoma

- Both IgH-Bcl-2 and cmyc translocations
- Other patients with advanced aggressive disease
- Subset arise from low grade FL

<table>
<thead>
<tr>
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<th>Diffuse large B-cell lymphoma</th>
<th>Burkitt lymphoma</th>
<th>DLBCL</th>
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<td>Ki67</td>
<td>40-100%</td>
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Burkitt Lymphoma

- Clinical features:
  - Highly aggressive but potentially curable
  - C-myc oncogene activation
  - Dx dictates a special aggressive chemo regimen
  - Nodal and extranodal sites
  - 20-30% involve CNS
  - 3 forms:
    - Endemic in Africa & Asia
    - EBV positive
    - Sporadic
    - Immunodeficiency-associated
- Cytologic features:
  - Uniform intermediate-size lymphs
  - Round nuclei with coarse chromatin
  - Scant vacuolated cytoplasm
  - Mitoses and apoptosis
- IHC and Molecular:
  - CD19/20+
  - IgH+.
  - Monotypic.
  - 100% Ki67+
  - C-myc rearrangement
  - FISH (highly sensitive)
- DDX:
  - Other large cell lymphoma/DLBCL

Plasmablastic Lymphoma

- Clinical features:
  - Rare lymphoma
  - HIV-positive or immunodeficient patients
  - Oral cavity and LN sites
- Cytologic features:
  - Unique morphologic vs immunophenotypic features
  - Resembles B immunoblasts
  - Large cells with large nucleoli
- IHC and Molecular:
  - Plasma cell phenotype: CD138+, CD38+, IRF4/MUM1+, CD45-, CD20-, PAX5-, CD56-
  - EBER+
- DDX:
  - Non-hematolymphoid neoplasms/carcinomas which can express CD138
Some Basics About T-Cell Lymphomas

- Approx 10% of all NHL
- Numerous subtypes
  - Broadly divided into:
    - Precursor T-cell lymphoblastic lymphoma
    - Mature T-cell lymphoma
    - NK-cell lymphoma
- Generally NOT associated with specific immunophenotypic profile
  - Dx suggested by aberrant T-cell immunophenotype
- No convenient antigenic markers of monoclonality
  - PCR for T-cell receptor gene rearrangement often needed to confirm clonality
- Most do not have specific genetic abnormalities

Peripheral T-Cell Lymphoma, Unspecified

- Clinical features:
  - More common in Asia
  - Elderly
  - Fears, night sweats, bulky lymphadenopathy
- Cytologic features:
  - Small, large, or mixed pattern of lymphocytes
  - Irregular nuclei
  - Admixed histiocytes, plasma cells, eosinophils
    - Reed-Sternberg-like cells
- IHC and Molecular:
  - T-cell phenotype
- DDX:
  - Hodgkin lymphoma
  - Other small and large cell lymphomas

Anaplastic Large Cell Lymphoma

- Clinical features:
  - 3% of adult NHL
  - 10-30% of childhood NHL
  - Usually T-cell neoplasm
  - Subset are null cell with T-cell receptor rearrangement
- Cytologic features:
  - Large pleomorphic cells
    - Hallmark cell
      - Horseshoe-shaped nuclei
    - RS-like cells
    - Mixed lymphoid background
    - Necrosis and inflammation
    - No TBM or lymphohistiocytic aggregates
- IHC and Molecular:
  - 60-85% are positive by IHC for ALK
  - ALK positive has better prognosis
  - ALK negative more common in elderly
    - CD30+, ALK+, EMA+, clusterin+, EBER negative
    - T(2;5) or similar ALK translocation
- DDX:
  - Carcinoma and other non-lymphoid malignancies
Non-Lymphoid Mimics of Large Cell Lymphomas: Dispersed Cell Patterns of Non-Lymphoid Malignancies

**Large B-cell Lymphoma**
- CD45+, Lympho-Glandular bodies

**Malignant Melanoma**
- S-100+, HMB45+

**Medullary Carcinoma**
- Ker+, Calcitonin +

**Small Cell Carcinoma**
- Ker+, Syn+, Cell cohesion

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Precursor T- and B-Cell Lymphoblastic Lymphoma

**Clinical features:**
- Aggressive lymphoma - 90% are T-cell
- 90% of childhood NHL
- Anterior mediastinal mass is common
- Upper body lymphadenopathy
- TdT (+)

**Cytologic features:**
- Entirely lymphoblasts
- Round or convoluted nuclei with fine chromatin
- Indistinct nucleoli
- Scant or moderate cytoplasm

**IHC and Molecular:**
- Tdt (+) is characteristic
- CD10+
- Negative for LCs

**DDX:**
- Thymoma
- Other large cell lymphomas and tumors

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Post Transplant Lymphoproliferative Disorder

**Clinical features:**
- Heterogeneous lymphomas and neoplastic
- 1-2% of solid-organ and BM transplant patients
- 80% associated with EBV infection
- 1-2% of solid-organ and GI tract
- Acute or chronic disease

**Cytologic features:**
- Dependent upon subtype of PTLD
- Mixed polymorphous patterns to large cell
- Reed-Sternberg or Reed-Sternberg-like PTLD

**IHC and Molecular:**
- EBER is very useful!!
- LC restriction by flow or IHC in many
- Some lack LC restriction - molecular testing needed to demonstrate clonality

**DDX:**
- Broad ddx
Summary

• FNA is an effective method to detect, diagnose, and subclassify lymphomas
• Without adequate material for ancillary studies, lymphoma classification is often insufficient to guide management and will lead to open bx
• Material needed for cytomorphology, flow cytometry, cell block for IHC, and molecular studies
• Work closely with your hematopathologists and get clinical info!!!!

Thank You!