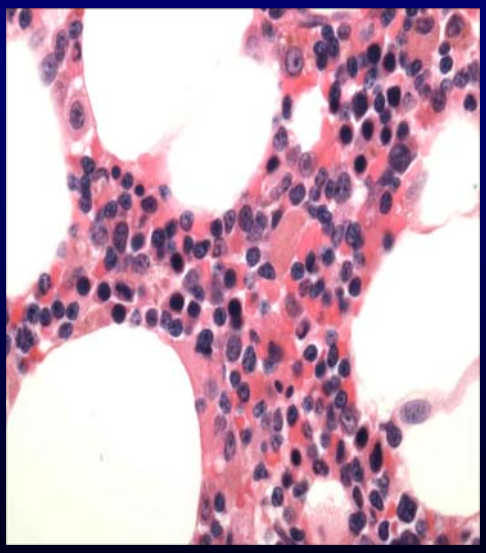
LYMPHOMA

BACHIR ALOBEID, M.D.
DEPARTMENT OF PATHOLOGY
Columbia University-College of Physicians & Surgeons

Lymphoma:
Neoplastic proliferation of lymphoid cells

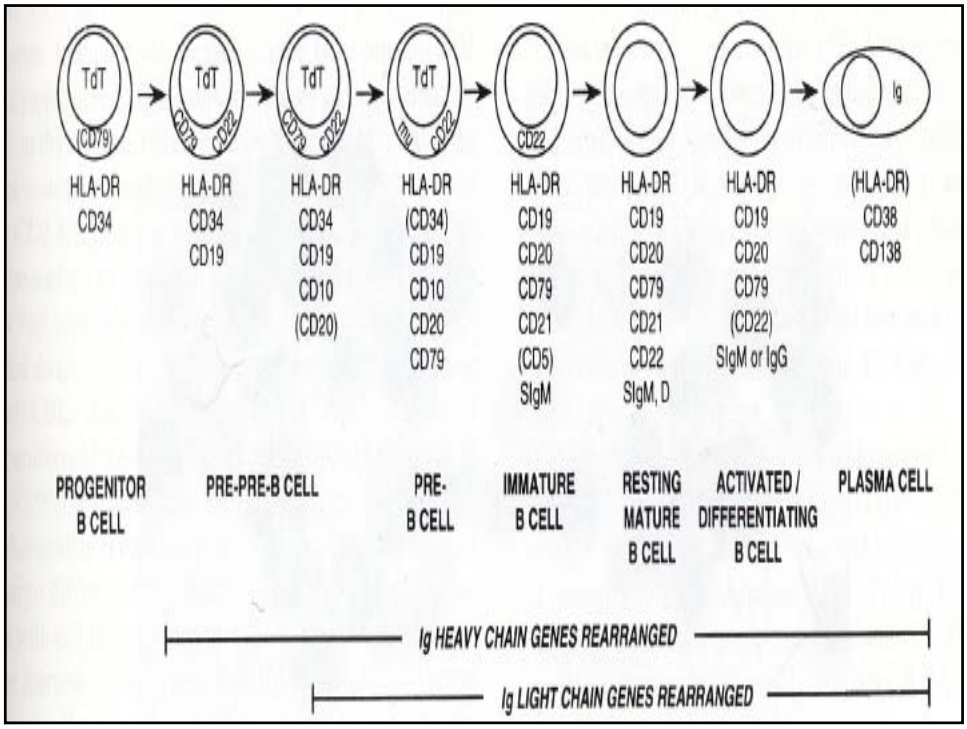
Normal development of lymphocytes

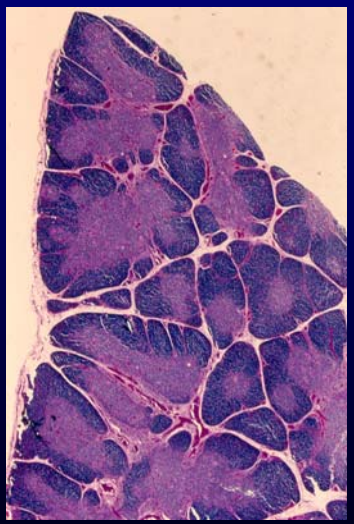


B-Cells

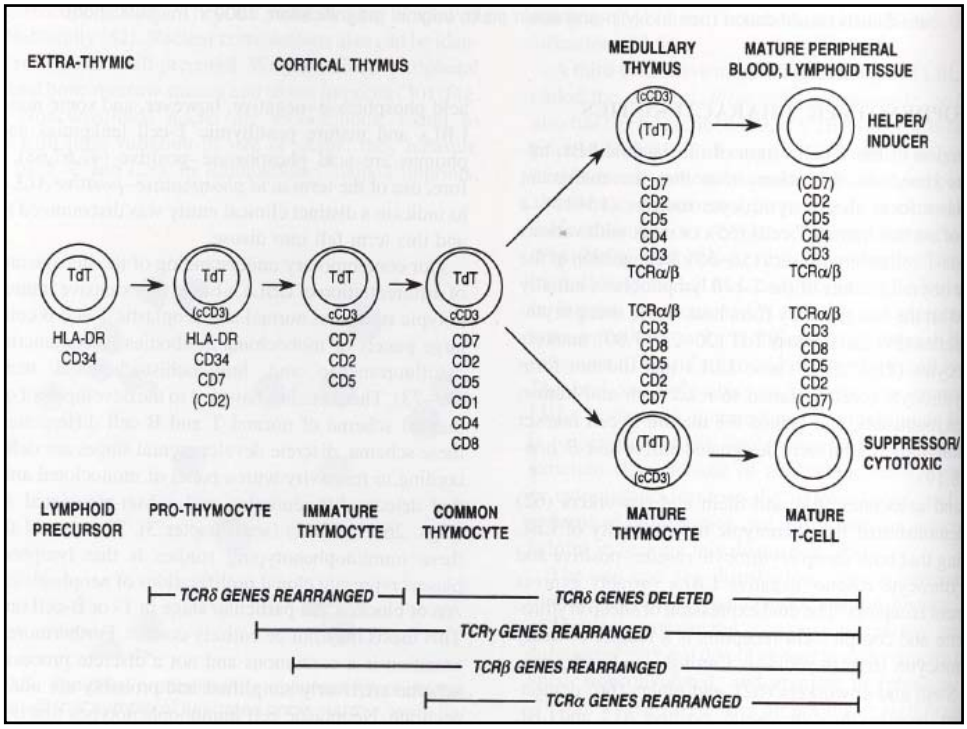
in the bone marrow

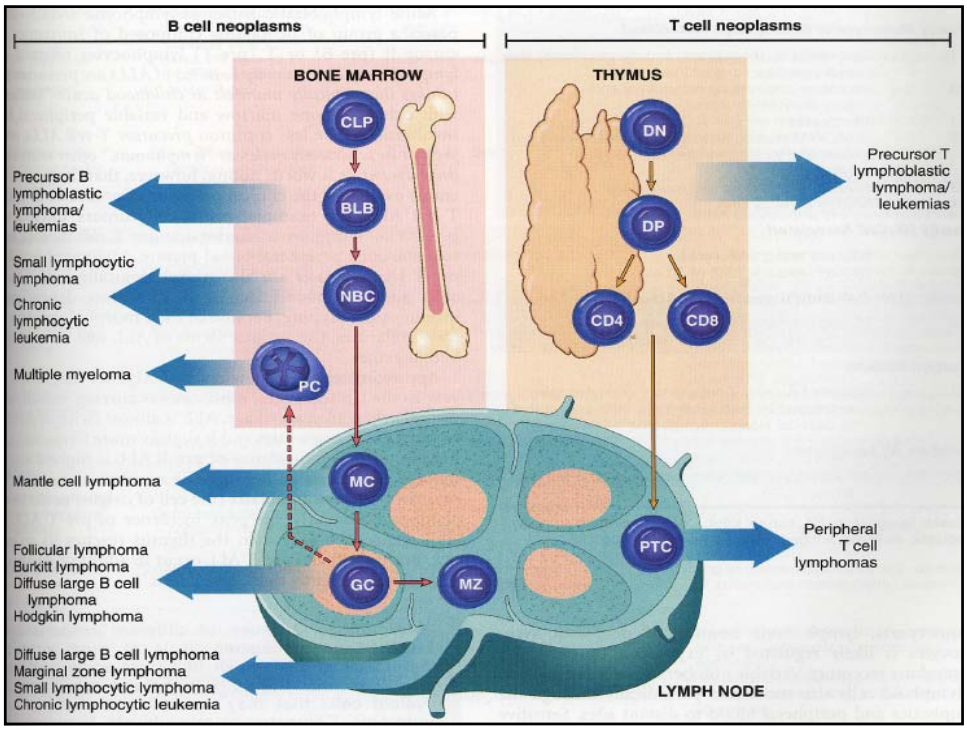
“hematogones”





T-Cells
in the thymus
“thymocytes”


EXTRA-THYMIC
CORTICAL THYMUS
MEDULLARY THYMUS
MATURE PERIPHERAL BLOOD, LYMPHOID TISSUE
TdT
(cCD3)
cCD3
HLA-DR CD34
HLA-DR CD34 CD7 (CD2)
CD7 CD2 CD5
CD7 CD2 CD5 CD1 CD4 CD8
CD7 CD2 CD5 CD4 CD3 TCRα/β
(CD7) CD2 CD5 CD4 CD3 TCRα/β
TCRα/β CD3 CD8 CD5 CD2 CD7
TCRα/β CD3 CD8 CD5 CD2 (CD7)
HELPER/ INDUCER
SUPPRESSOR/ CYTOTOXIC
LYMPHOID PRECURSOR
PRO-THYMOCYTE
IMMATURE THYMOCYTE
COMMON THYMOCYTE
MATURE THYMOCYTE
MATURE T-CELL
TCRδ GENES REARRANGED
TCRδ GENES DELETED
TCRγ GENES REARRANGED
TCRβ GENES REARRANGED
TCRα GENES REARRANGED


B cell neoplasms
T cell neoplasms
BONE MARROW
THYMUS
CLP
BLB
NBC
PC
MC
GC
MZ
DN
DP
CD4
CD8
PTC
LYMPH NODE
Precursor B lymphoblastic lymphoma/ leukemias
Small lymphocytic lymphoma
Chronic lymphocytic leukemia
Multiple myeloma
Mantle cell lymphoma
Follicular lymphoma
Burkitt lymphoma
Diffuse large B cell lymphoma
Hodgkin lymphoma
Diffuse large B cell lymphoma
Marginal zone lymphoma
Small lymphocytic lymphoma
Chronic lymphocytic leukemia
Precursor T lymphoblastic lymphoma/ leukemias
Peripheral T cell lymphomas

Normal Lymph Node

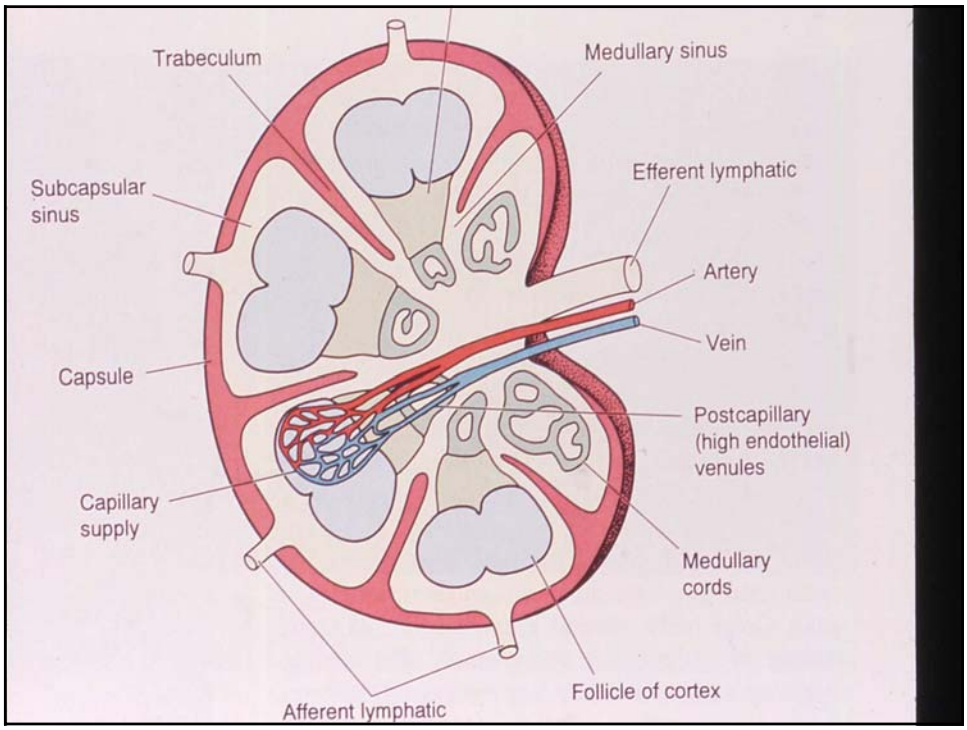
- **Normal compartments of the lymph node:**

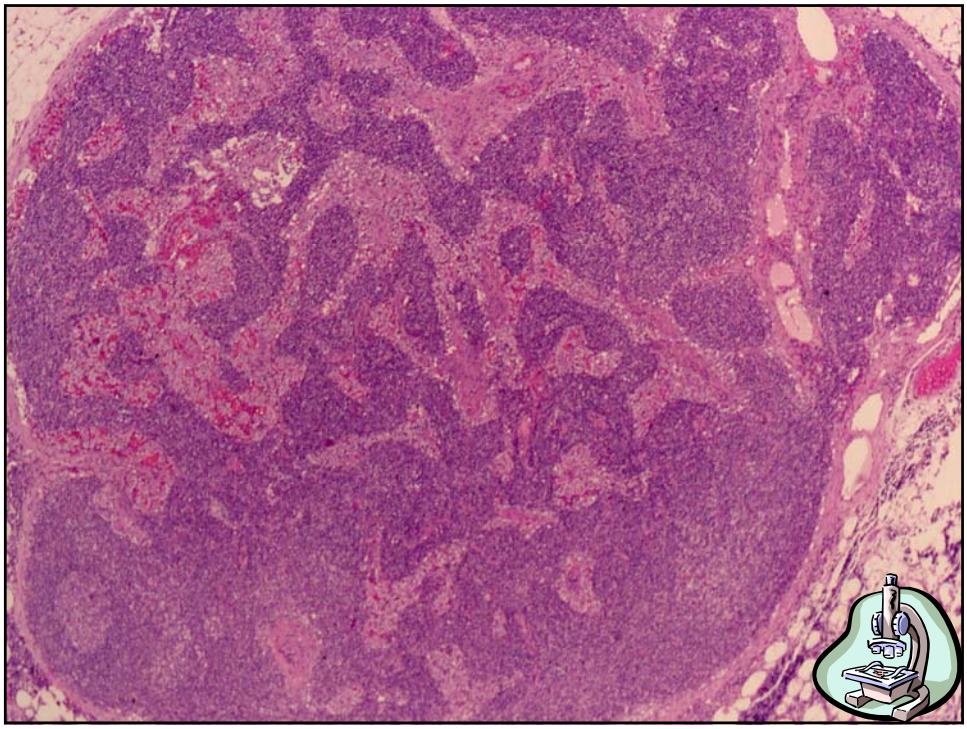
1- cortex / follicles

2- paracortex

3- medullary cords

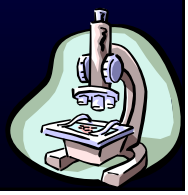
4- sinuses

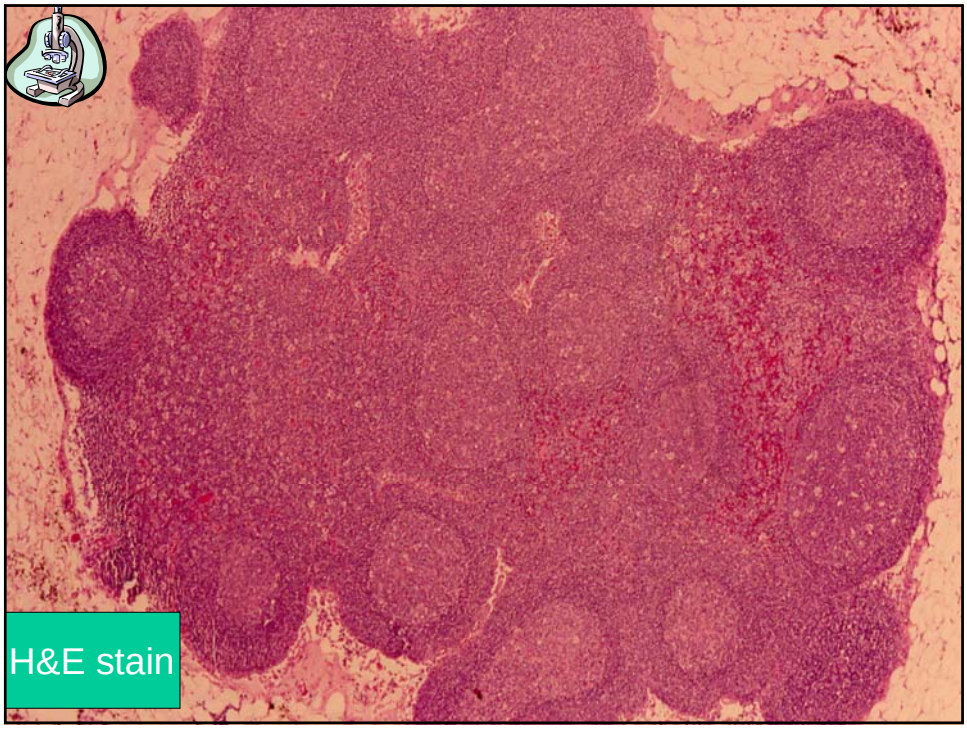




Diagnostic Methods

- **Gold standard method: Histomorphologic evaluation of the lymphoid tissues.**
- Sections of fixed tissue -embedded in paraffin- for routine H&E staining





Diagnostic Methods

Ancillary studies:

- **Immunophenotyping:**

1- Immunohistochemistry (IHC) and/or

2- Flow cytometry

Lymphoid Markers

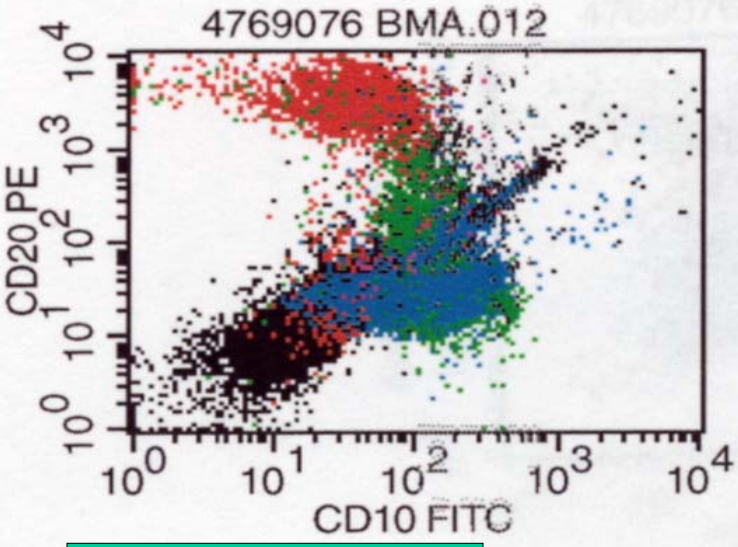
Lymphoid markers commonly used in immunophenotypic studies:

Pan-hematopoietic: CD45, CD43
B-cell markers: CD19, CD20, CD22, CD79a, Pax5, MUM1
T-cell markers: CD2, CD3, CD5, CD7,CD4, CD8
Germinal center cells: CD10, Bcl-6, HGAL
Follicular dendritic cells: CD21, CD23, CD35
Plasma cells: CD138, CD38, MUM1
Immature lymphoid cells: TdT, CD10, CD34, CD1a
Activated lymphoid cells: CD30, CD23
NK-cells: CD56, CD57

Diagnostic Methods

- **Flow cytometry (multi-parametric) analysis is the method of choice to demonstrate the intensity of antigen expression and simultaneous expression of multiple antigens..**

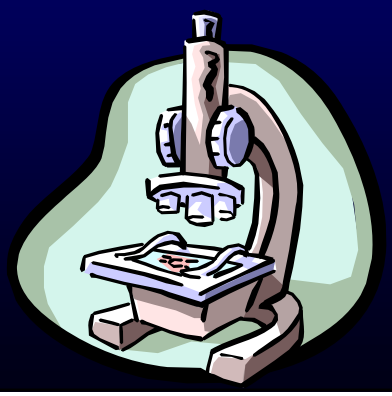
Cell suspensions and flow cytometer

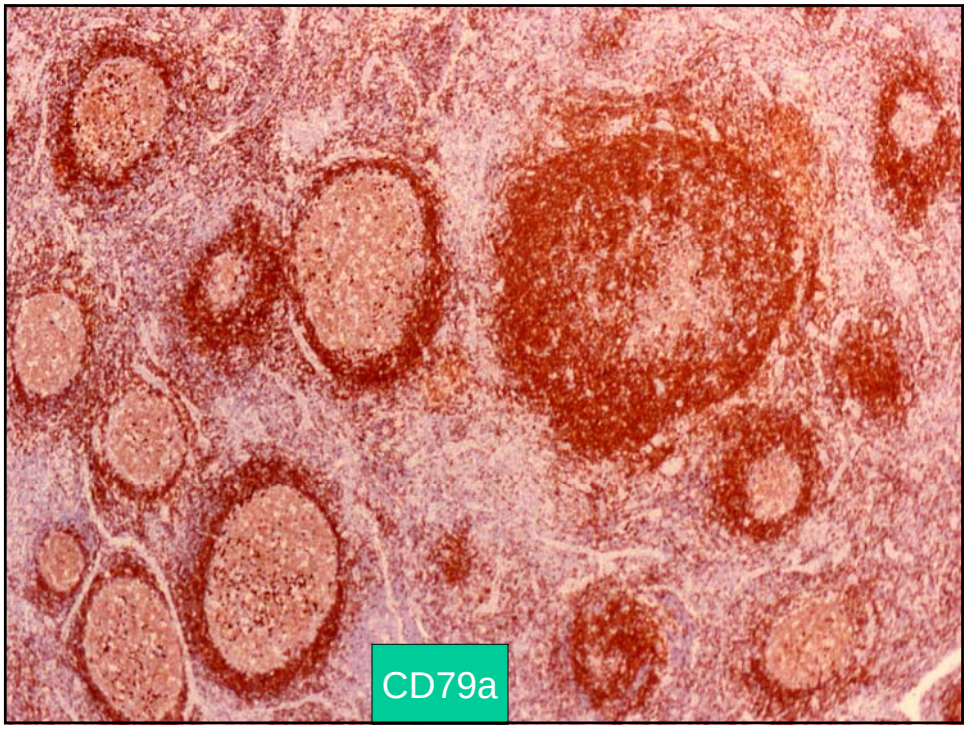


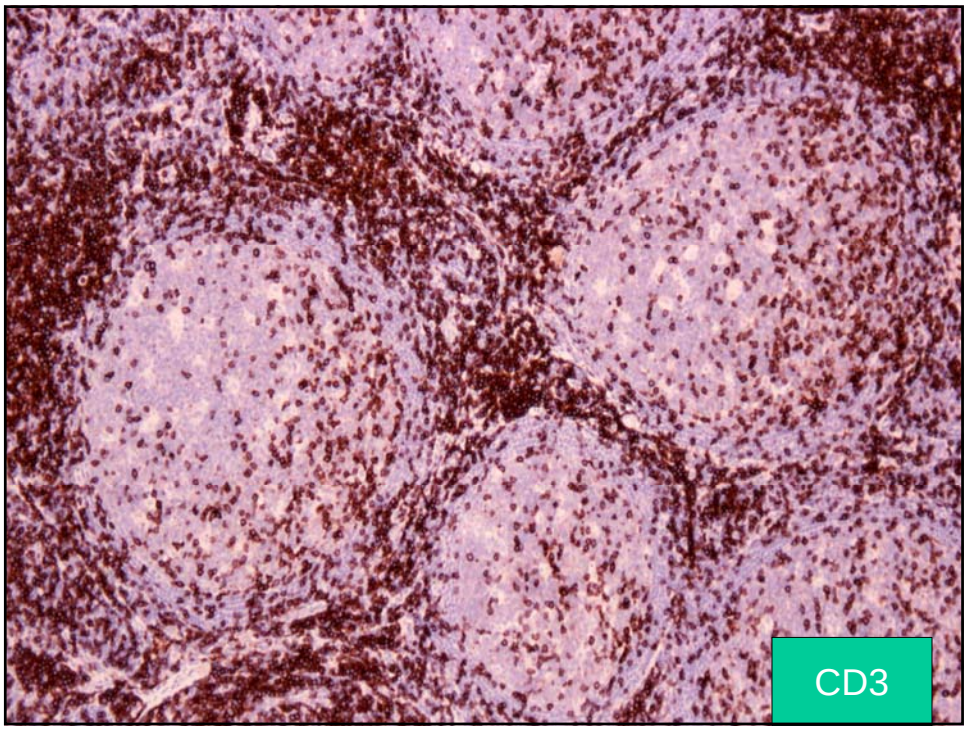
Flow cytometry, dot blot

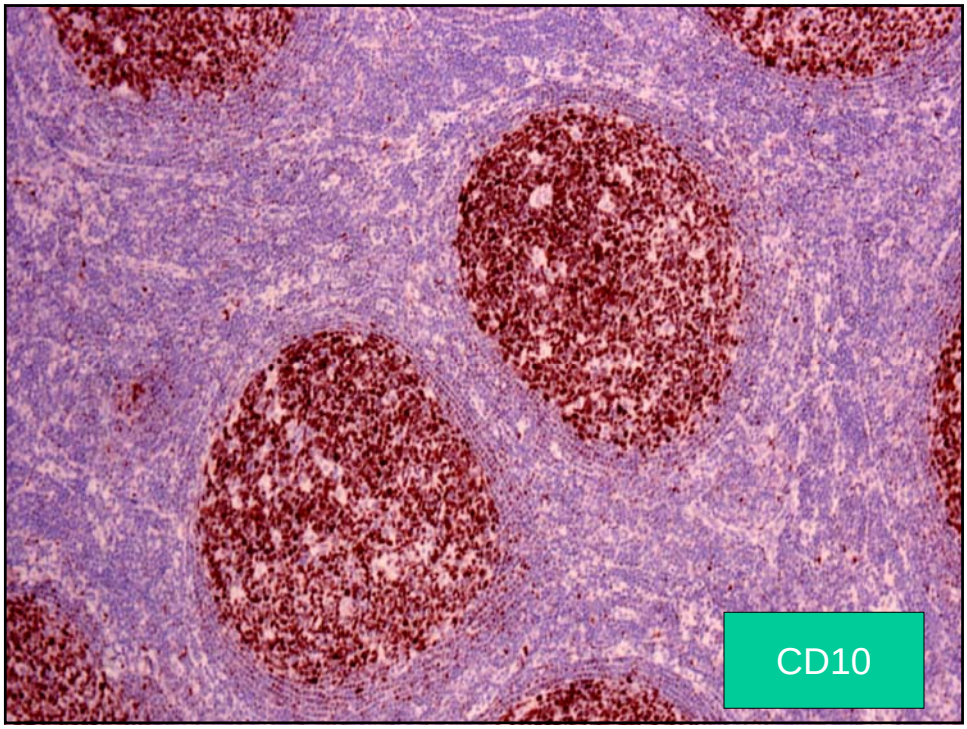
Diagnostic Methods

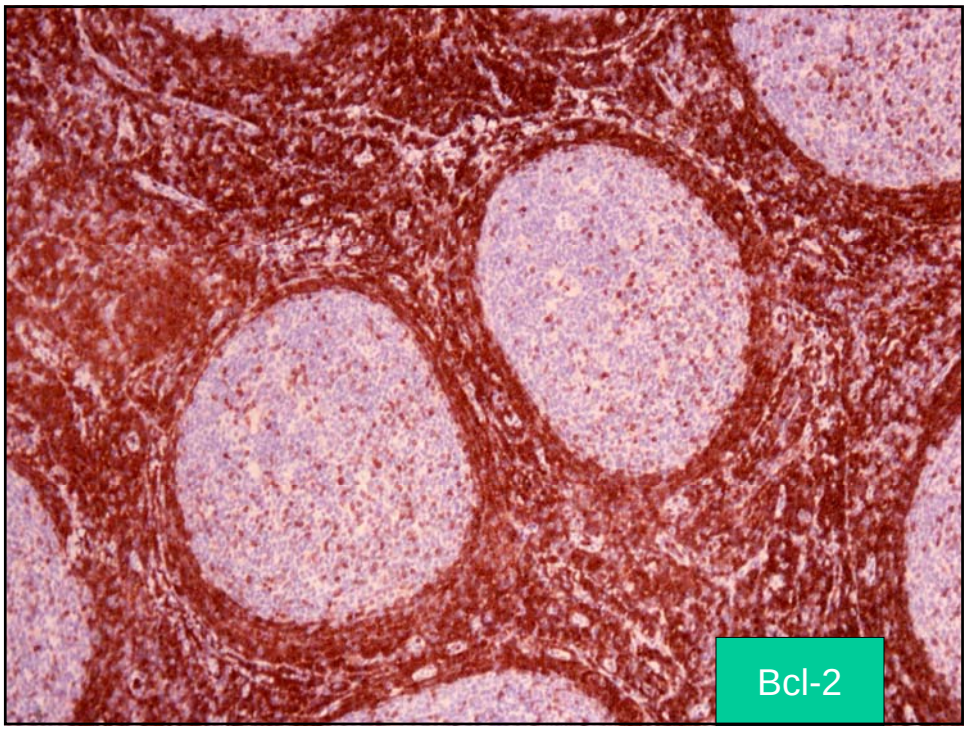
- **IHC is good to show the distribution and localization of different lymphoid elements in tissue sections..**




CD79a


CD3

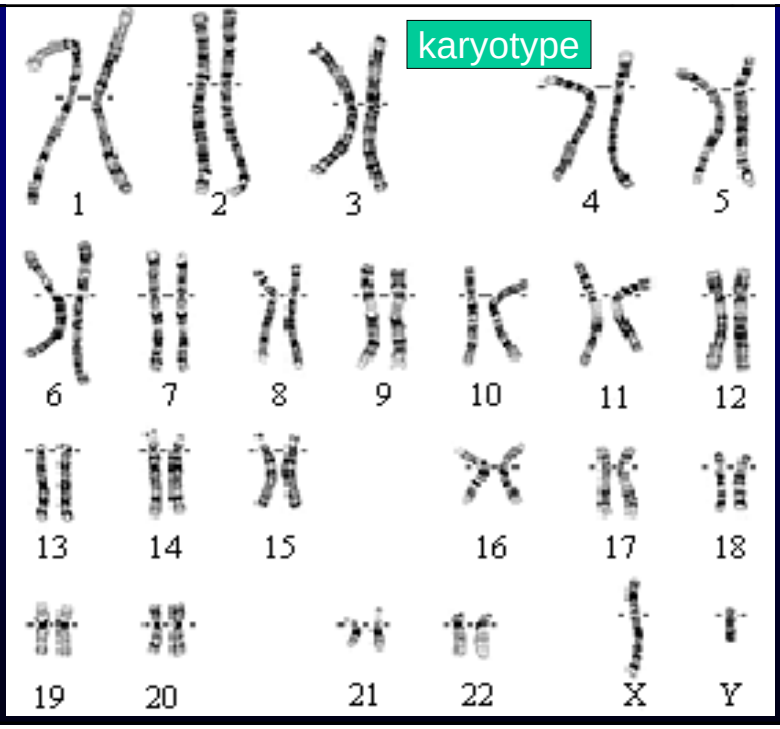

CD10

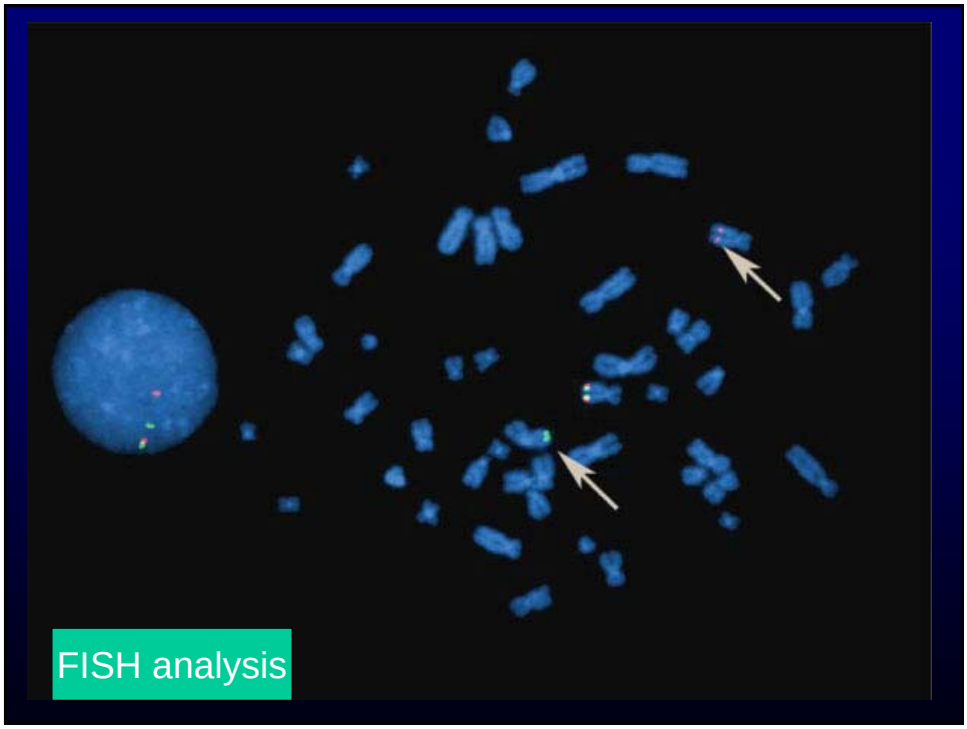

Bcl-2

Diagnostic Methods, cont.

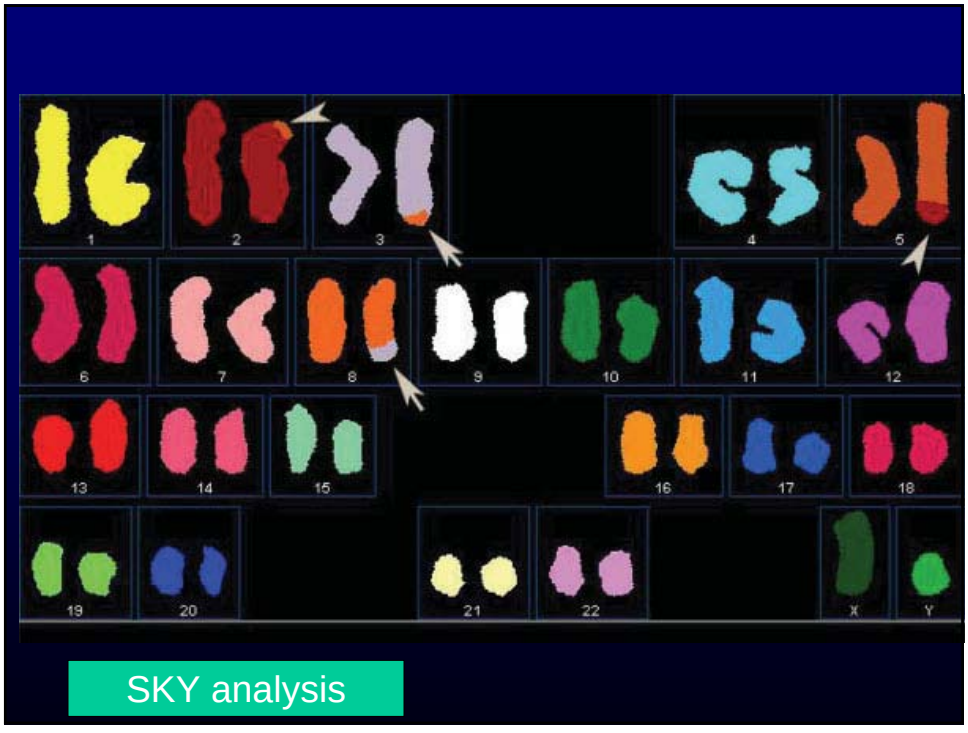
Ancillary studies:

- Cytogenetic studies: Conventional Karyotype analysis, FISH analysis, SKY analysis
- Molecular analysis: Southern blot and PCR

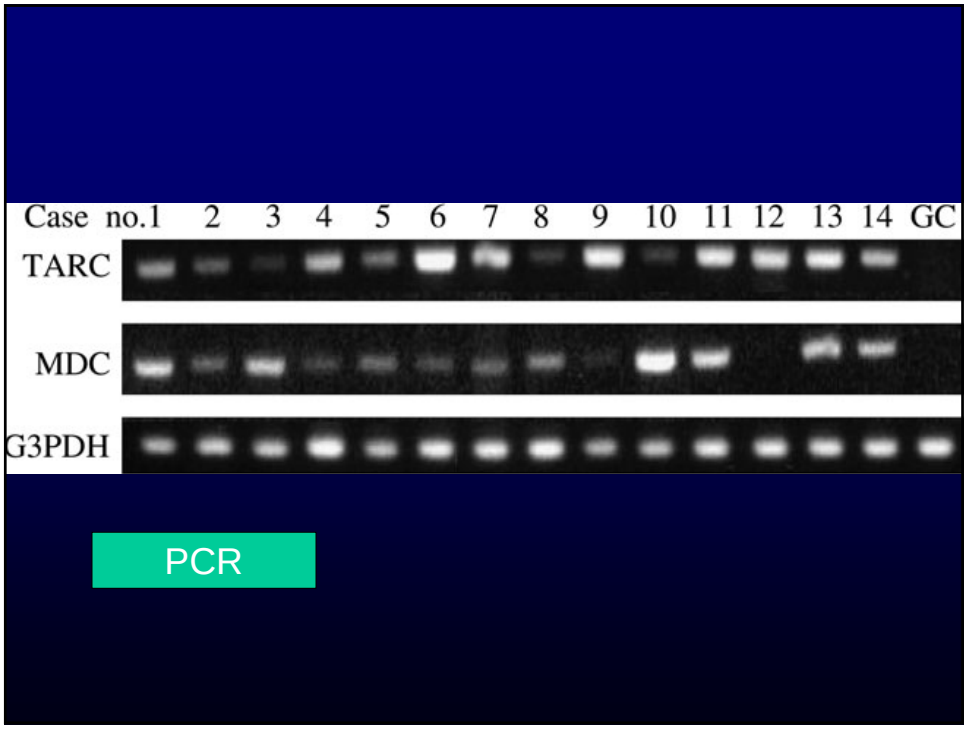




FISH analysis

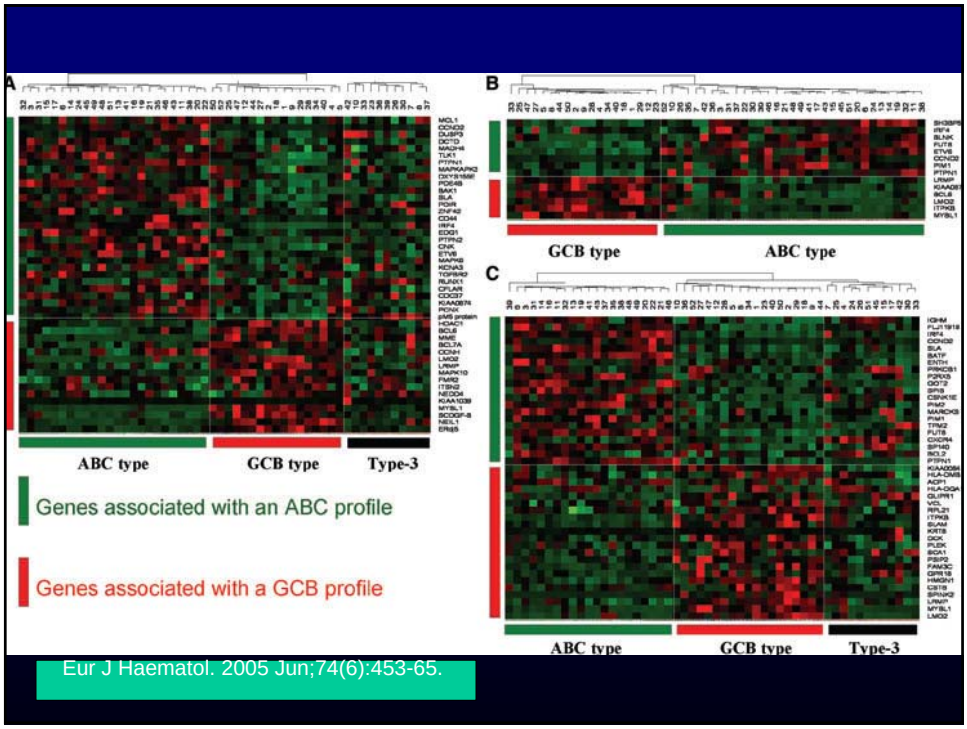


SKY analysis

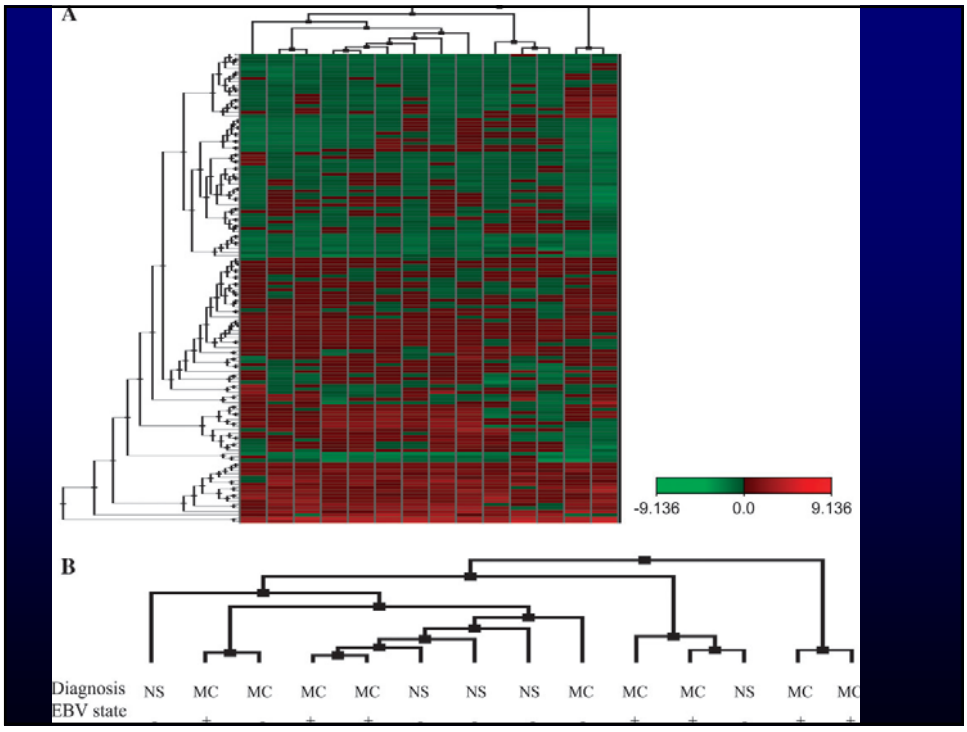


PCR

DNA microarray platforms: to demonstrate gene expression patterns/profiles; important methodology for the diagnosis and classification of hematological malignancies in the future



Eur J Haematol. 2005 Jun;74(6):453-65.



LYMPHOID DISORDERS

1- Benign (reactive) Lymphadenopathies

2- Malignant Lymphoproliferative Disorders/Lymphomas

3- Atypical (borderline/grey zone) Lymphoproliferative Disorders

LYMPHOMAS

- **Non-Hodgkin Lymphoma (NHL):**
  - ***1- B-cell lymphomas*** *(most common)*
  - ***2- T-cell and NK cell lymphomas***
- **Hodgkin Lymphoma (disease):**
  - ***1- Nodular Lymphocyte Predominance***
  - ***2- Classical Hodgkin Lymphoma***

Non-Hodgkin Lymphoma

- **Definition:**

Malignant neoplastic proliferation of lymphoid cells derived from a single transformed cell (monoclonal proliferation).

Non-Hodgkin Lymphoma

- **Epidemiology:**

- More common in the developed countries
- Frequency of different types varies around the world:

B- vs NK/T-cell..

Burkitt lymphoma..

adult T-cell leukemia/lymphoma..

Non-Hodgkin Lymphoma

- **Epidemiology, cont.:**

- Individuals with immunodeficiencies/immune disorders are at higher risk :

1- Congenital (primary) immunodeficiency

2- Acquired immunodeficiencies (HIV-related, post-therapy)

3- Autoimmune diseases..

Non-Hodgkin Lymphoma

- **Etiology:**

- **Infectious agents and development of lymphoma:**

- HTLV-1 infection and T-cell leukemia/lymphoma..
- Epstein-Barr virus (EBV) and Burkitt's lymphoma..
- Human herpesvirus-8 (HHV-8) and primary effusion lymphoma
- HCV and marginal zone lymphoma
- H. Pylori and gastric MALT lymphoma

Non-Hodgkin Lymphoma

- **Etiology, cont.:**

- Genetic alterations and development of lymphoma..

t(14;18) translocation and follicular lymphoma..

t(8;14) translocation and Burkitt's lymphoma..

t(11;14) translocation and mantle cell lymphoma..

Non-Hodgkin Lymphoma

- **Classification of NHLs:**

* Rappaport Classification:

Based on morphology; growth pattern (diffuse vs. nodular) and cytomorphology..

* Working Formulation (1984):

Based on morphology; divides NHLs into prognostic groups (useful to clinicians) and can be applied in the absence of immunophenotypic studies..

Non-Hodgkin Lymphoma

- **Classification of NHLs, cont.:**

***** Revised European American Lymphoma (REAL) Classification (1994):

This classification system recognizes specific (real) disease entities based on immunophenotypic, cytogenetic, and molecular features, as well as conventional morphology.

Non-Hodgkin Lymphoma

WHO Classification (2001):

An updated version of the REAL classification..

Expanded the principles of the REAL classification to the classification of the myeloid and histiocytic neoplasms..

Replaced existing classifications..

The first international consensus..

WHO Classification

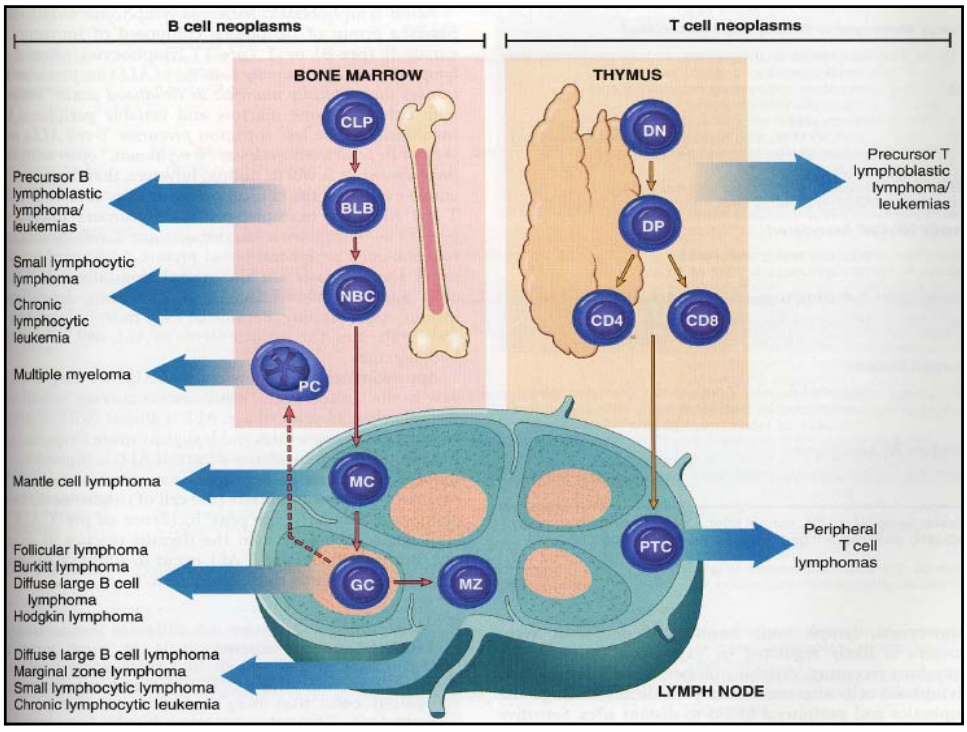
- Precursor (immature) B- and T-cell Lymphoid Neoplasms (leukemia/lymphoma):

  Precursor lymphblastic leukemia/lymphoma

- Mature (peripheral) B- and T-cell Lymphoid Neoplasms:

  Mature B-cell lymphomas

  Mature NK/T-cell lymphomas



WHO Classification

- Immunodeficiency Associated Lymphoproliferative Disorders:

1. Lymphoproliferative diseases associated with primary immune disorders
2. Lymphomas associated with infection by HIV
3. Post-transplant lymphoproliferative disorders
4. Methotraxate-associated lymphoproliferative disorders

Non-Hodgkin Lymphoma

- **Clinical manifestations of NHL:**

1- Lymphadenopathy..

2- Organomegaly (infiltration of organs)..

3- Systemic/B symptoms (fever, night sweats, weight loss)..

Non-Hodgkin Lymphoma

- ***Examples of NHL:***

Diffuse Large B-cell Lymphoma (DLBCL), most common lymphoma in the western hemisphere

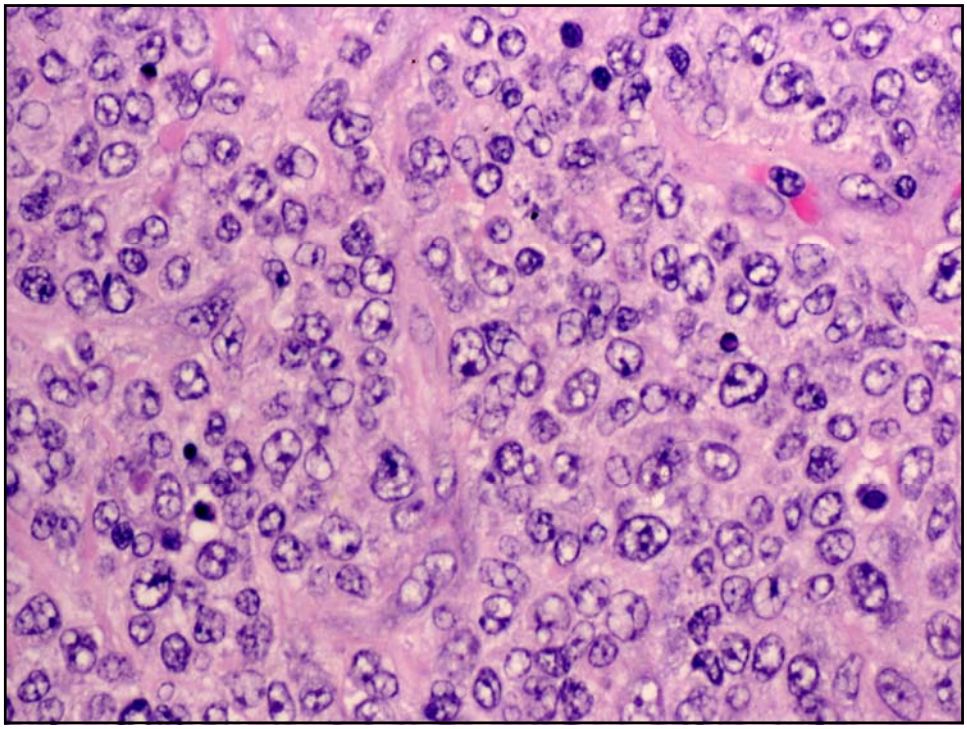
Follicular Lymphoma (FL)

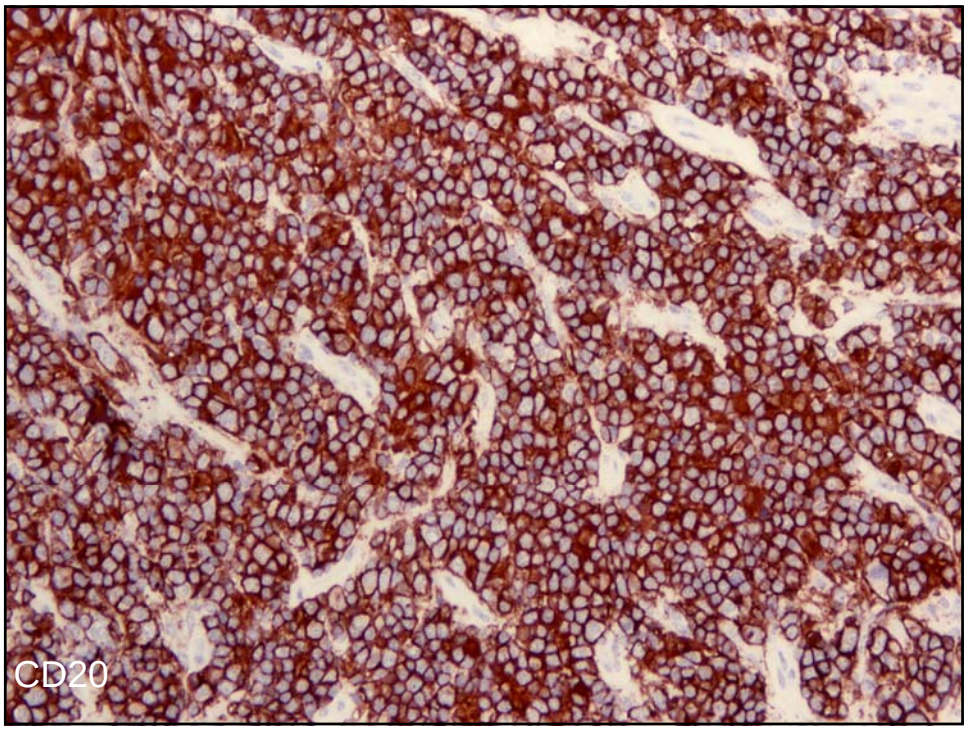
Burkitt Lymphoma (BL)

Non-Hodgkin Lymphoma

Diffuse Large B-cell Lymphoma

A diffuse proliferation of large neoplastic B lymphoid cells with a nuclear size equal to or exceeding normal macrophage nuclei or more than twice the size of a normal lymphocyte




CD20

Recent studies using gene expression profiling (GEP) in DLBCL have identified patterns of gene expression, as well as individual genes that appear to have important prognostic significance, related to underlying tumor biology.

At least two types:

1- DLBCL of germinal center cell origin

CD10+ and/or BCl-6+

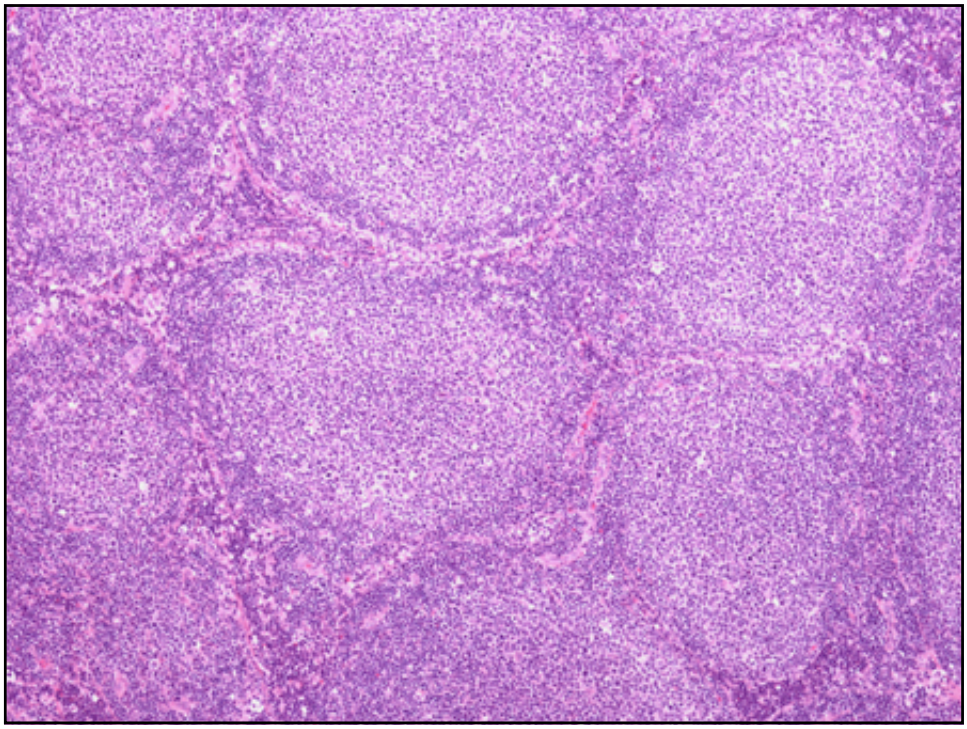
2- DLBCL activated B-cell like

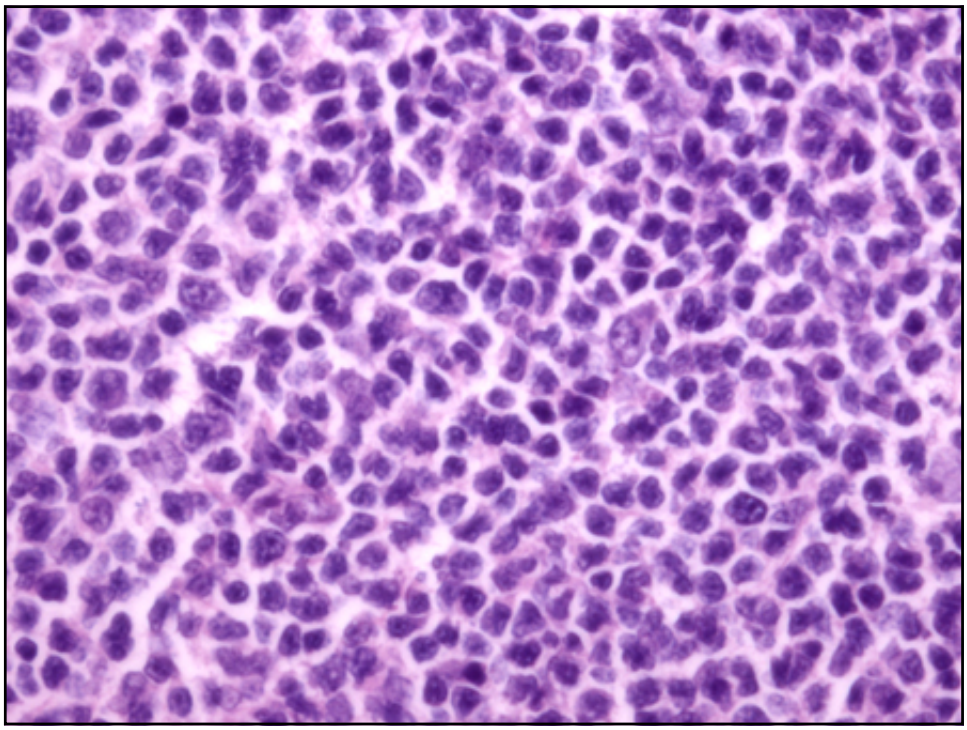
CD10- and MUM1+

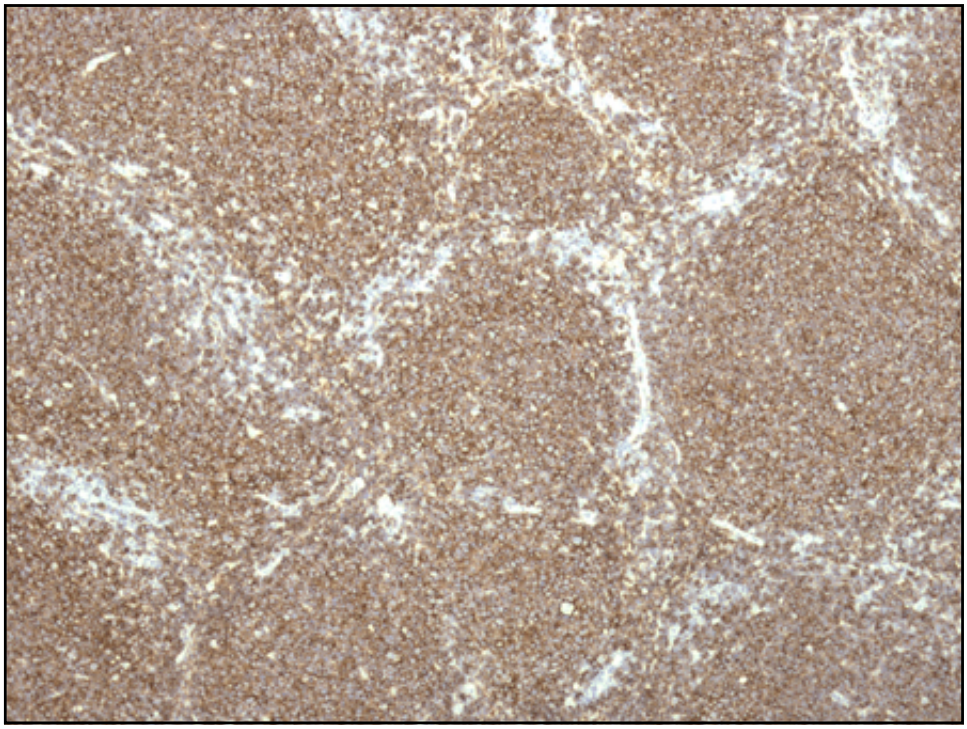
Non-Hodgkin Lymphoma

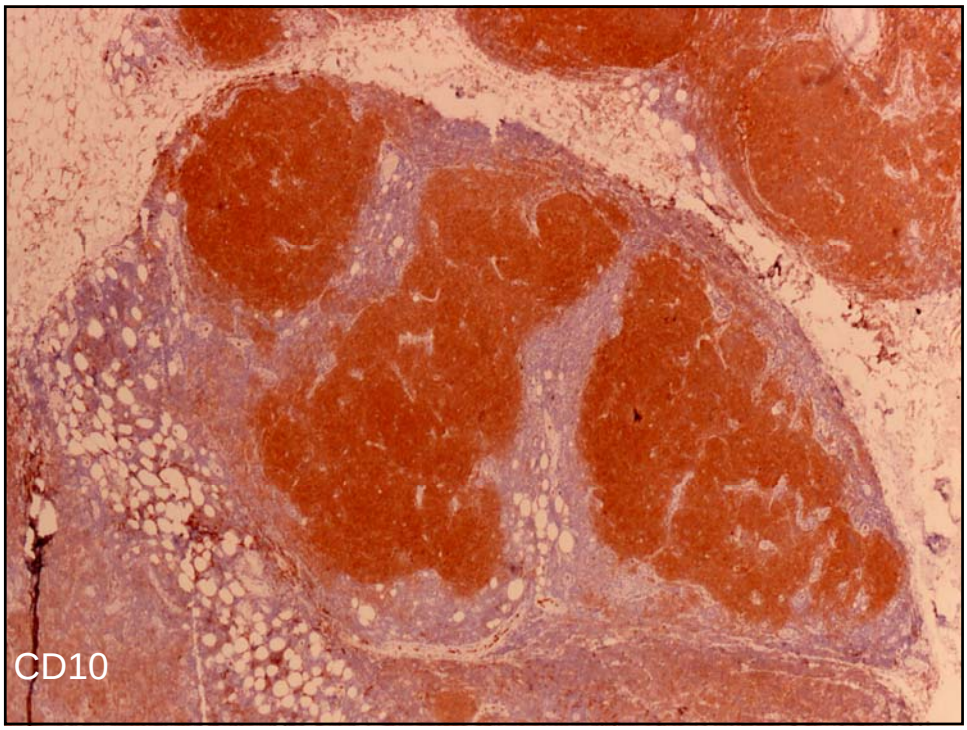
Follicular Lymphoma

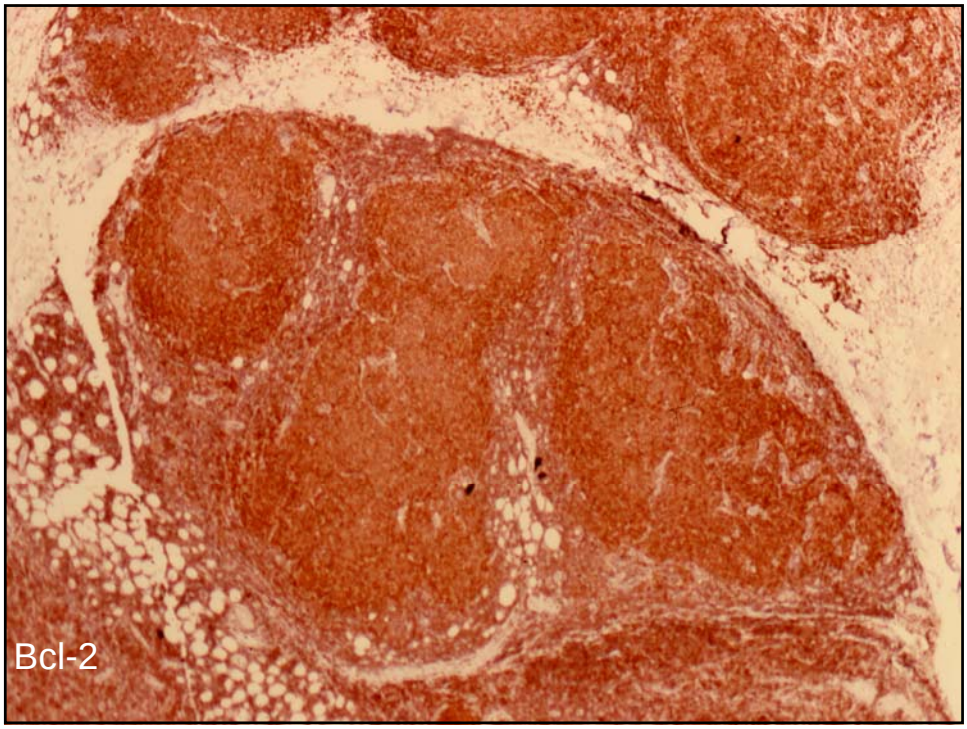
A neoplasm of follicle center B cells (a mixture of centrocytes/centroblasts), which has at least a partially follicular/nodular pattern of growth







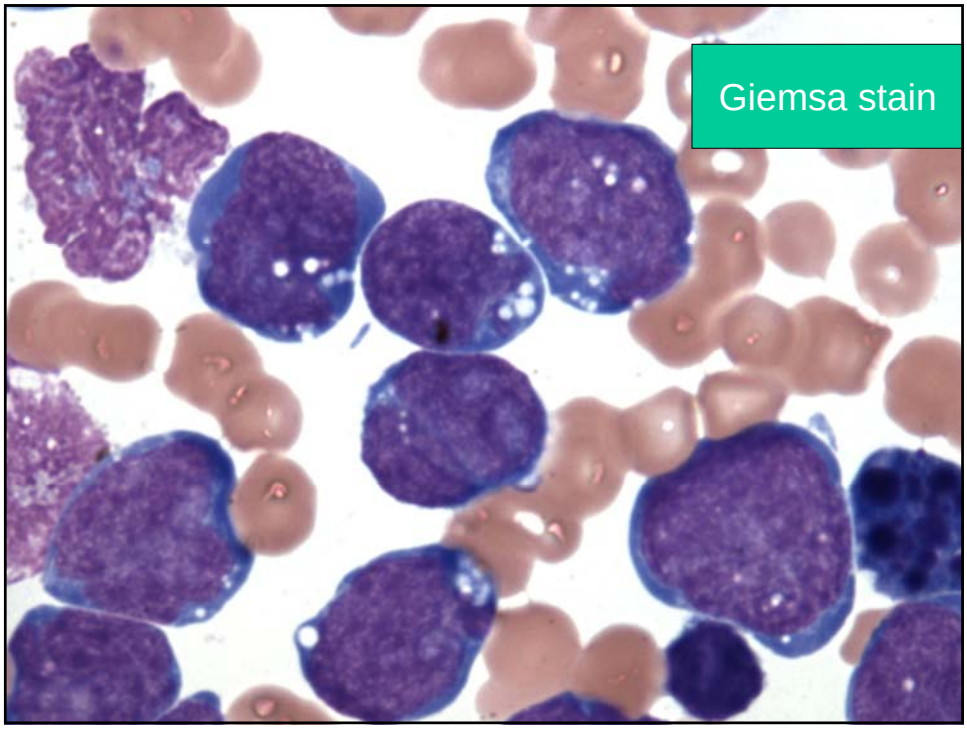

CD10

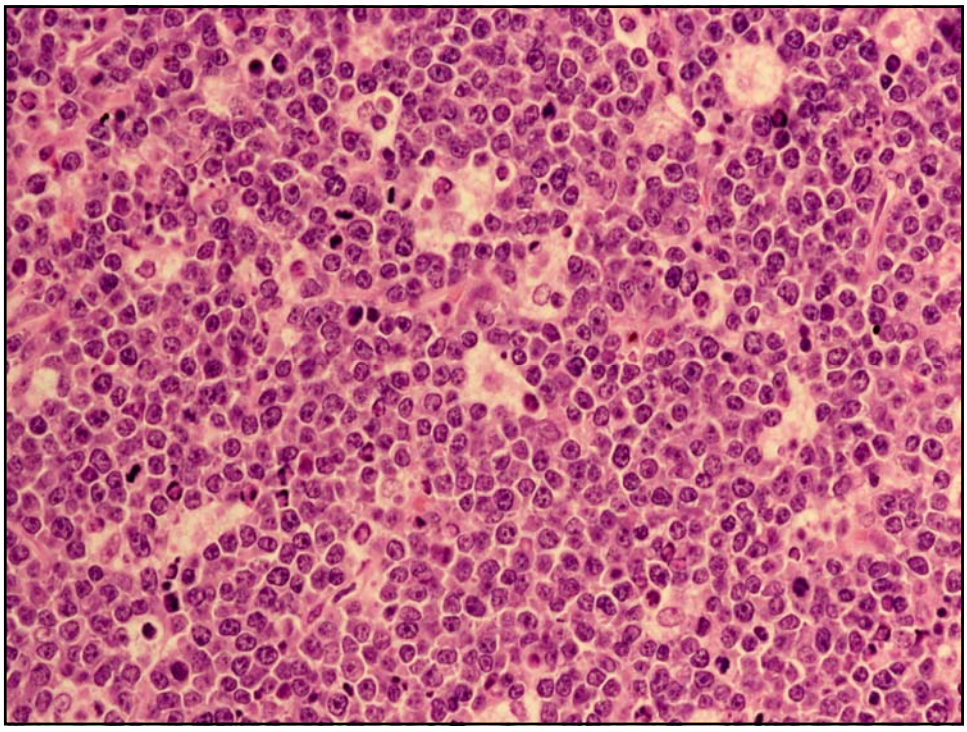


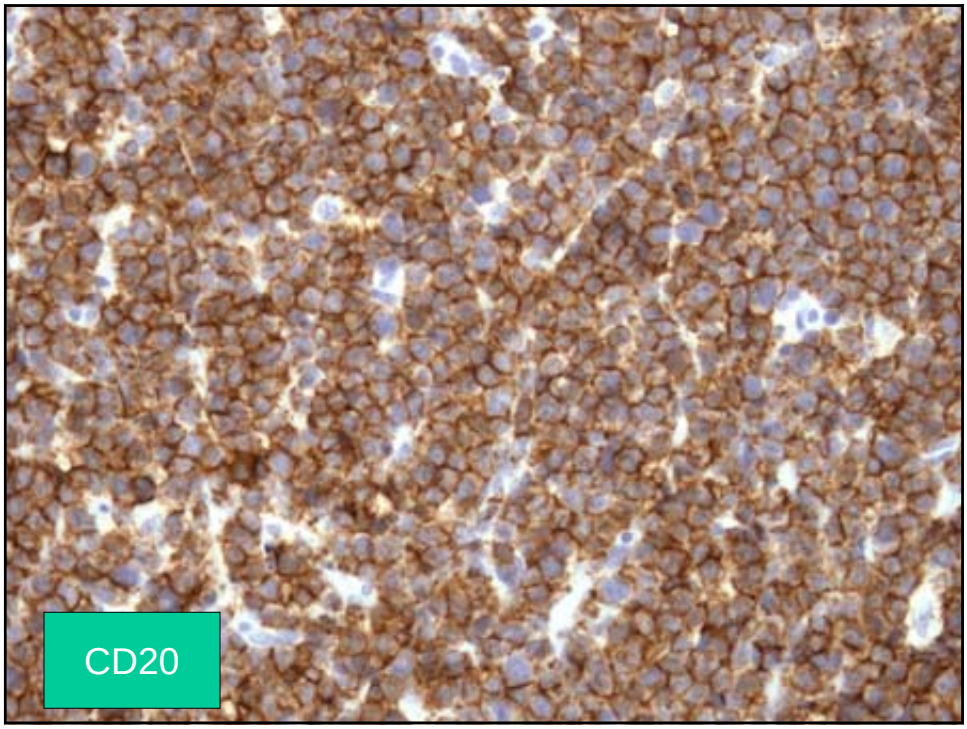
Non-Hodgkin Lymphoma

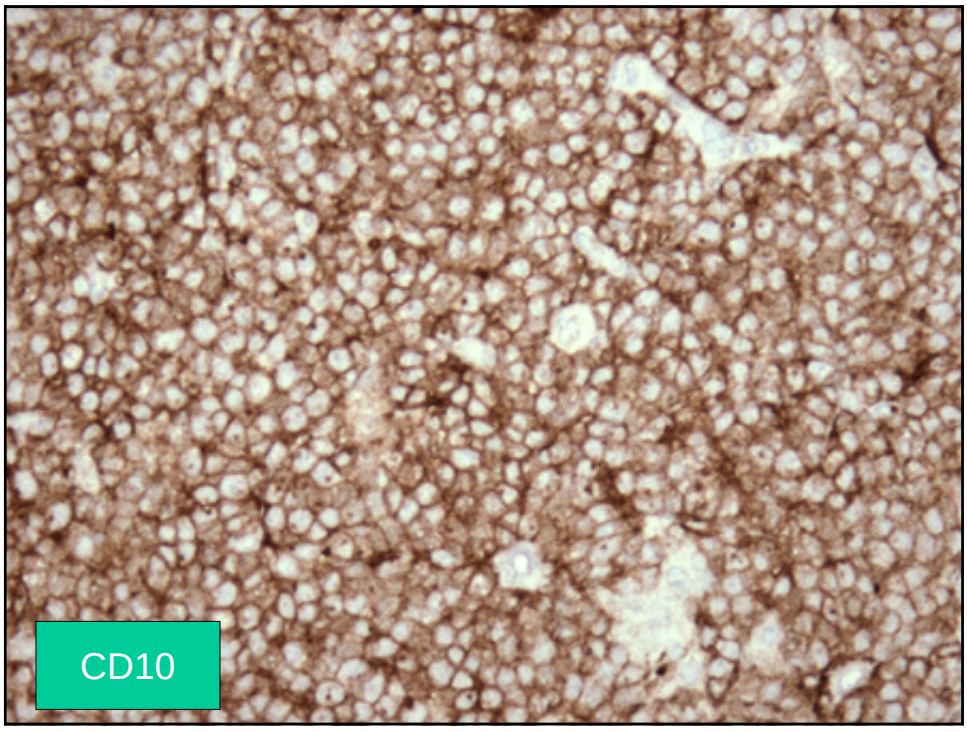
Burkitt Lymphoma

A highly aggressive lymphoma often presenting at an extra-nodal site or in a leukemic phase, composed of monomorphic medium-sized B-cells with basophilic/vacuolated cytoplasm and numerous mitotic figures


Giemsa stain




CD20


CD10

Non-Hodgkin Lymphoma

- **Therapy of NHL:**

1- Chemotherapy

2- Radiotherapy

3- Combined chemo- and radiotherapy

4- Immune therapy: antibodies raised against B-cell antigens (anti- CD20/anti-CD22 antibodies)

Hodgkin Lymphoma

- **Definition:**

Lymphoid neoplasm with a minority of neoplastic lymphoid cells (*Hodgkin cells*) in a predominant inflammatory/reactive background which may mask the tumor cell population

Hodgkin Lymphoma

- **Epidemiology & Etiology :**
- accounts approximately for 30% of all malignant lymphomas
- bimodal age distribution
- EBV has been postulated to play a role in the pathogenesis of classical HL

Hodgkin Lymphoma

- **WHO Classification of HL:**

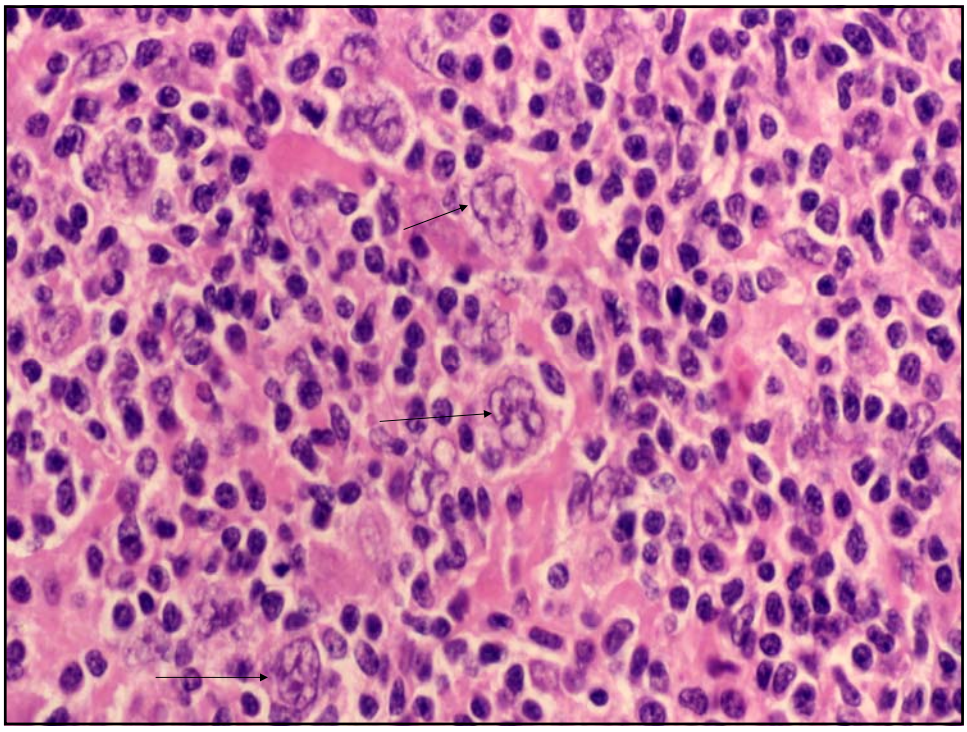
1- Nodular Lymphocyte Predominance

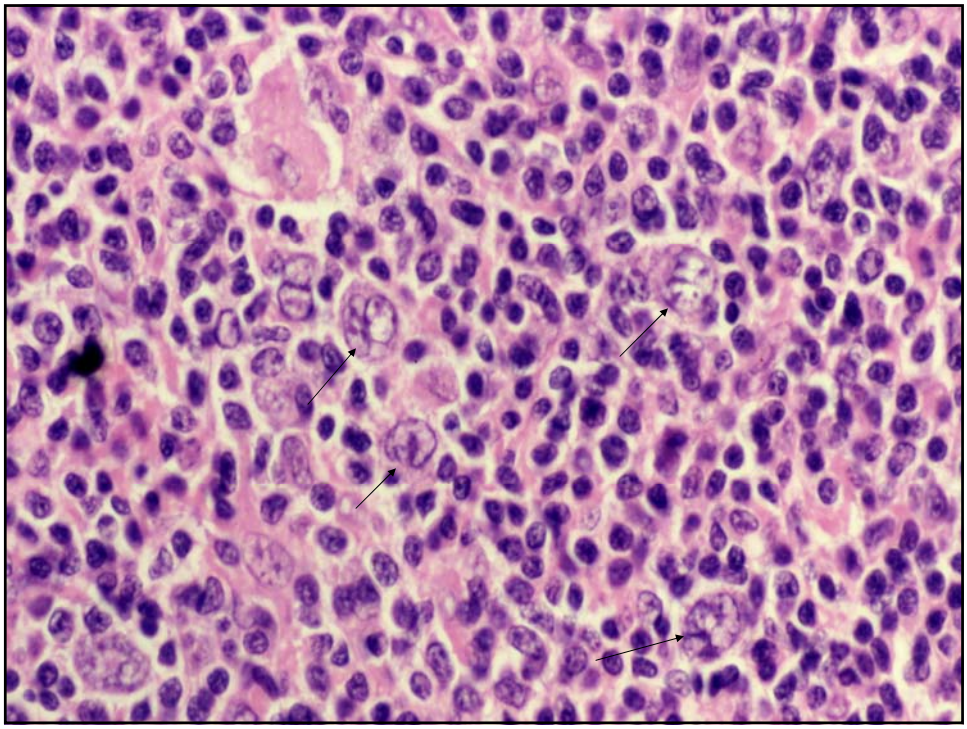
2- Classical Hodgkin Lymphoma

Hodgkin Lymphoma

- **Nodular Lymphocyte Predominance:**

- uncommon variant (6% of HL)
- characteristic nodular pattern of growth
- characteristic variant of Hodgkin cells (known as “popcorn” cells), which are CD20 positive B-cells of follicle center cell origin (CD10+, Bcl-6+)





Hodgkin Lymphoma

Classical Hodgkin Lymphoma:

Nodular sclerosis (NSHL)

Mixed cellularity (MCHL)

Lymphocyte depletion (LDHL)

Lymphocyte-rich classical Hodgkin lymphoma (LRCHL)

Hodgkin Lymphoma

Classical Hodgkin Lymphoma:

Hodgkin cells: derived from mature B-cells at the germinal center stage of differentiation

- typical Reed-Sternberg cells (binucleated cells)
- variants (mono- and multinucleated forms and lacunar cells)

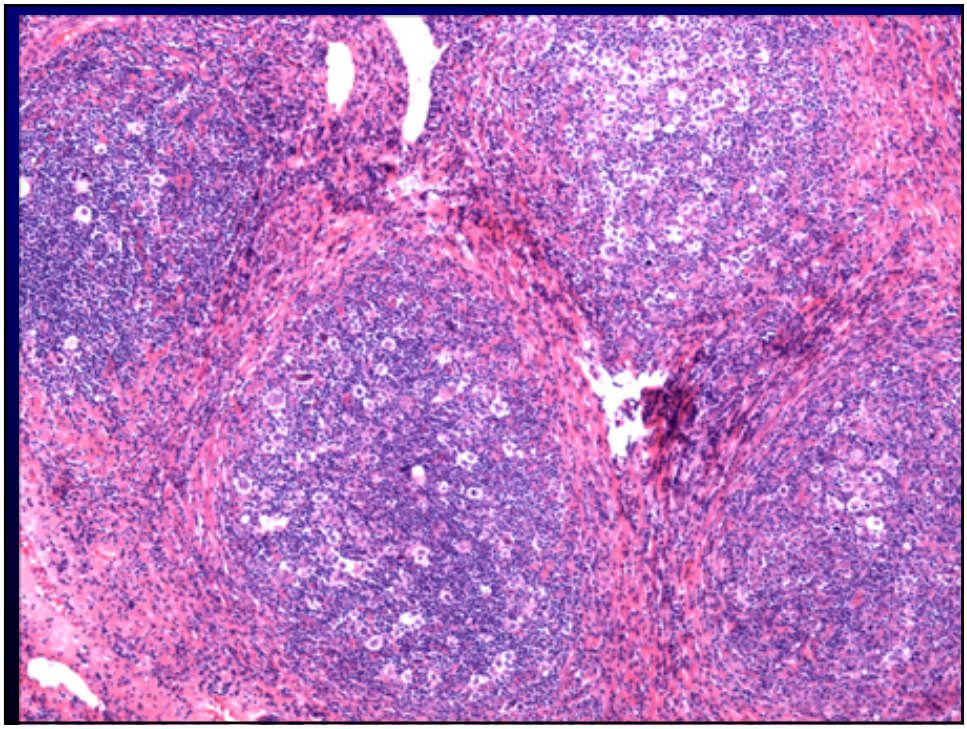
Immunophenotype: CD30+, CD15+, Pax5+, and CD45 negative

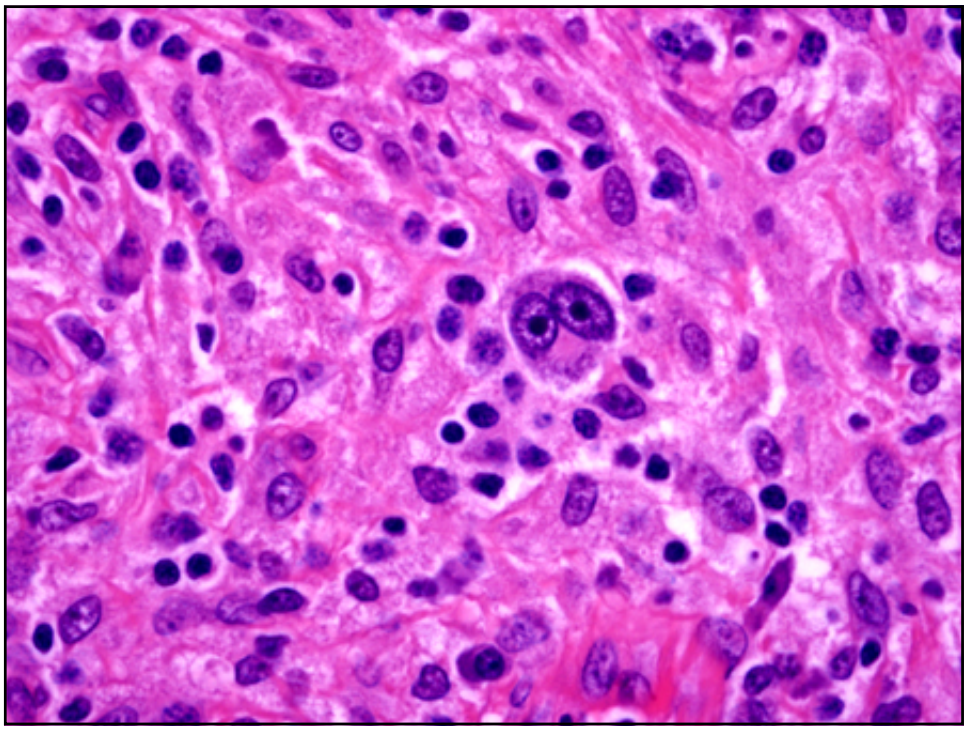
Hodgkin Lymphoma

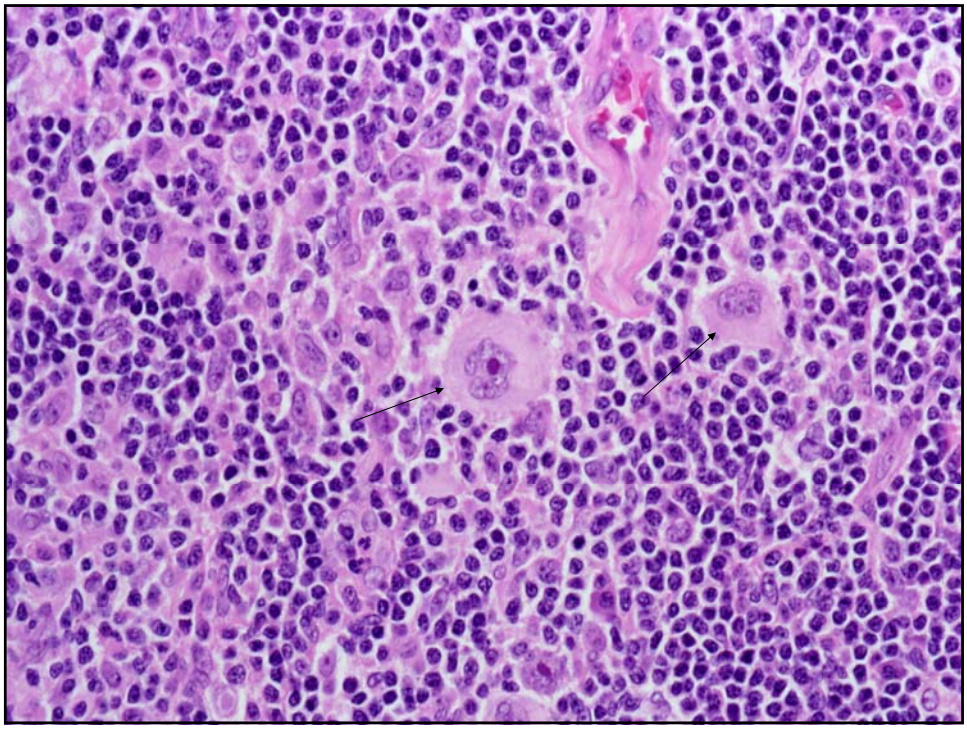
Classical Hodgkin Lymphoma:

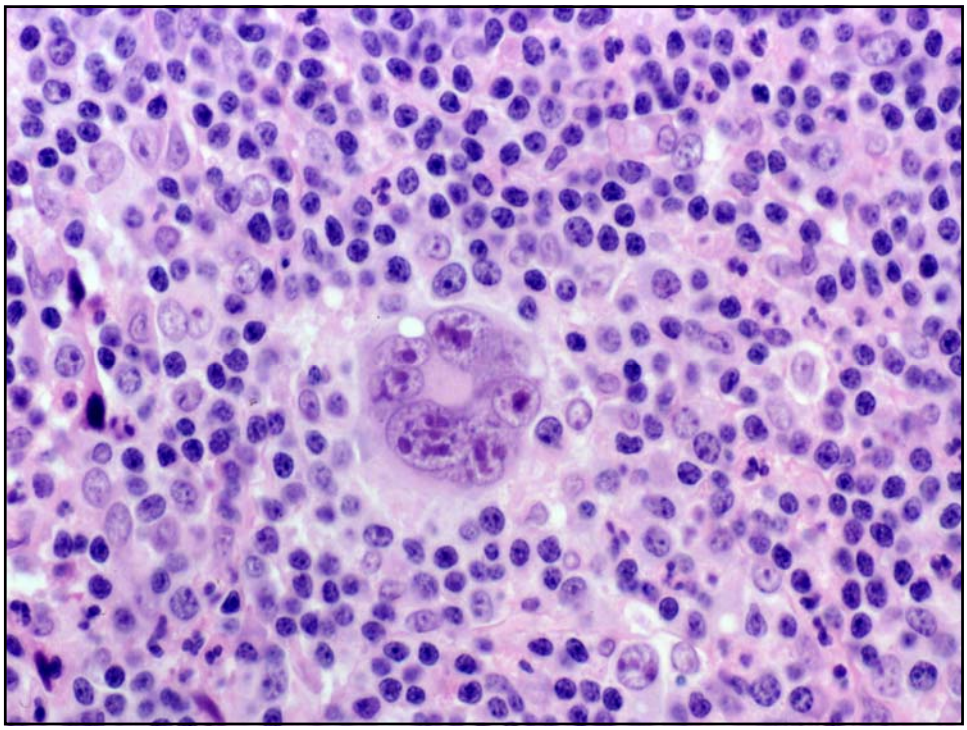
Nodular sclerosis (NSHL):

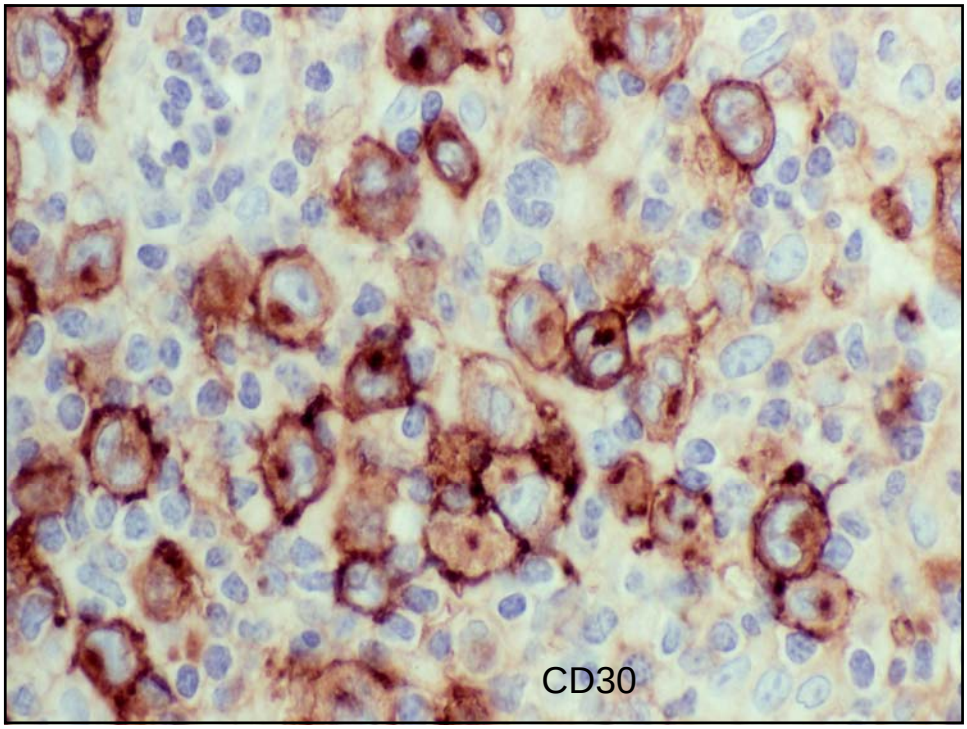
- characterized by Reed-Sternberg cells and ***lacunar cells*** within a polymorphic reactive background, and a characteristic ***fibrosis*** (bands of collagen surrounding nodules)







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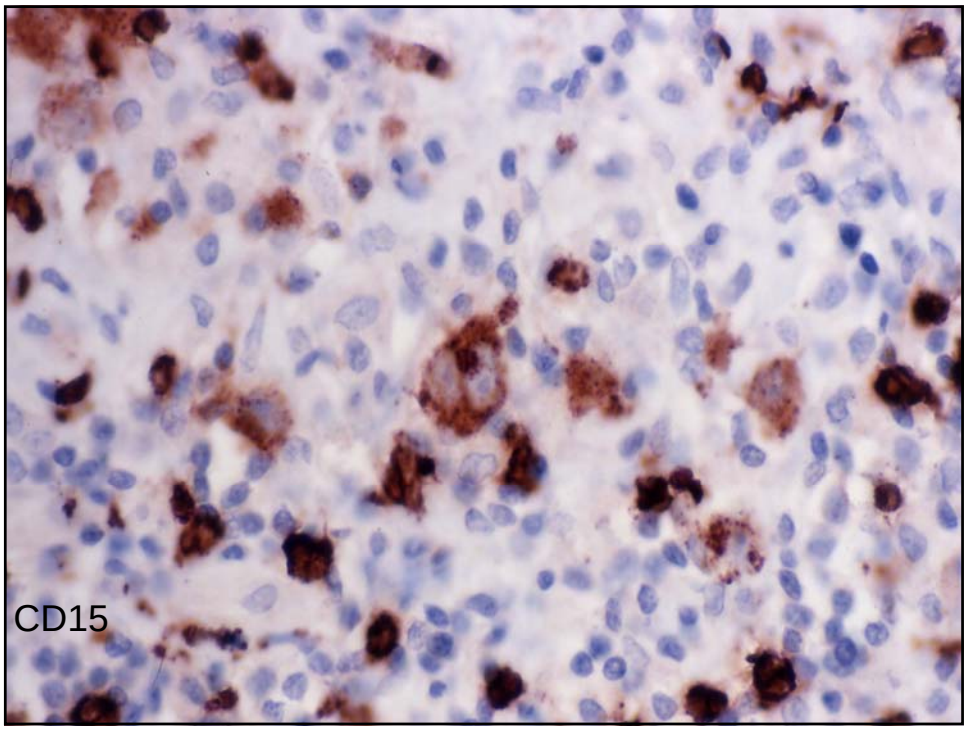
CD15

Hodgkin Lymphoma

Classical Hodgkin Lymphoma:

Mixed cellularity (MCHL):

- classical Reed-sternberg cells in a mixed, polymorphic bachground; no lacunar cells or collagen bands

Lymphocyte depletion (LDHL):

- uncommon subtype
- rich in Hodgkin's cells

Hodgkin Lymphoma

- **Clinical manifestations of HL:**

1- Lymphadenopathy

2- Organomegaly (infiltration of organs)

3- Systemic/B symptoms (fever, night sweats, weight loss)

Hodgkin's Lymphoma

- **Therapy of HL:**

1- Chemotherapy

2- Radiotherapy