MAYO CLINIC LABORATORIES

Test Definition: LLPB

Leukemia/Lymphoma Immunophenotyping, Flow Cytometry, Blood

Overview

Useful For

Evaluating lymphocytoses of undetermined etiology

Identifying B- and T-cell lymphoproliferative disorders involving blood

Distinguishing acute lymphoblastic leukemia (ALL) from acute myeloid leukemia (AML) using whole blood specimens

Immunologic subtyping of ALL

Distinguishing reactive lymphocytes and lymphoid hyperplasia from malignant lymphoma using whole blood specimens

Distinguishing between malignant lymphoma and acute leukemia using whole blood specimens

Phenotypic subclassification of B- and T-cell chronic lymphoproliferative disorders, including chronic lymphocytic leukemia, mantle cell lymphoma, and hairy cell leukemia

Recognizing AML with minimal morphologic or cytochemical evidence of differentiation

Recognizing monoclonal plasma cells

Reflex Tests

Test Id	Reporting Name	Available Separately	Always Performed
FCINT	Flow Cytometry Interp, 2-8 Markers	No, (Bill Only)	No
FCIMS	Flow Cytometry Interp, 9-15 Markers	No, (Bill Only)	No
FCINS	Flow Cytometry Interp,16 or greater	No, (BIll Only)	No

Additional Tests

Test Id	Reporting Name	Available Separately	Always Performed
FIRST	Flow Cytometry, Cell Surface, First	No, (Bill Only)	Yes
ADD1	Flow Cytometry, Cell Surface, Addl	No, (Bill Only)	Yes

Testing Algorithm

A screening triage panel is initially performed to evaluate for monotypic B cells by kappa and lambda light chain expression, increased numbers of blast cells by CD34 and CD45 expression along with side scatter gating, and increased plasma cells by CD45 expression and side scatter gating. The triage panel also includes antibodies to assess the number of CD3-positive T cells and CD16-positive/CD3-negative natural killer cells present. This triage panel also determines if there is an increase in the number of T cells that aberrantly coexpress CD16, an immunophenotypic feature of T-cell granular lymphocytic leukemia.

If no abnormalities are detected by the initial panel, no further flow cytometric assessment will be performed unless otherwise indicated by specific features of the clinical presentation or prior laboratory results.

The triage screen panel, together with the provided clinical history and morphologic review, is used to determine what, if any, additional marker testing is needed for disease diagnosis or classification. If additional testing is required, it will be added per the algorithm to fully characterize a disease state with a charge per unique antibody tested. Possible additional panels containing specific markers include, but are not limited to, the following: T-cell panel, B-cell panel, acute panel, myeloperoxidase/terminal deoxynucleotidyl transferase (MPO/TdT) panel, killer-cell immunoglobulin-like receptor panel, B-cell acute lymphoblastic leukemia (ALL) panel, plasma cell panel.

Method Name
Immunophenotyping

NY State Available
No

Specimen

Specimen Type
Whole blood

Ordering Guidance
This test is appropriate for hematopoietic peripheral blood specimens only.

For bone marrow specimens, order LLBM / Leukemia/Lymphoma Immunophenotyping by Flow Cytometry, Bone Marrow.

For solid tissue specimens, order LLTS / Leukemia/Lymphoma Immunophenotyping, Flow Cytometry, Tissue.

For body fluid and cerebrospinal fluid specimens, order LLBF / Leukemia/Lymphoma Immunophenotyping, Flow Cytometry, Body Fluid

Shipping Instructions
Specimen must arrive within 96 hours of collection.

Specimen Required

Specimen Type: Whole blood
Container/Tube:
Preferred: Yellow top (ACD solution A or B)
Acceptable: Lavender top (EDTA)
Specimen Volume: 6 mL
Slides: If possible, include 5 to 10 unstained blood smears labeled with **two unique identifiers**
Collection Instructions:
1. Send whole blood specimen in original tube. **Do not aliquot**.
2. Label specimen as blood.

Specimen Minimum Volume

3 mL

Reject Due To

Gross hemolysis	Reject

Specimen Stability Information

Specimen Type	Temperature	Time	Special Container
Whole blood	Ambient	4 days	

Clinical & Interpretive

Clinical Information

Diagnostic hematopathology has become an increasingly complex subspecialty, particularly with neoplastic disorders of blood and bone marrow. While morphologic assessment of blood smears, bone marrow smears, and tissue sections remains the cornerstone of lymphoma and leukemia diagnosis and classification, immunophenotyping is a very valuable and important complementary tool.

Immunophenotyping hematopoietic specimens can help resolve many differential diagnostic problems posed by the clinical or morphologic features.

Reference Values

An interpretive report will be provided.

This test will be processed as a laboratory consultation. An interpretation of the immunophenotypic findings and correlation with the morphologic features will be provided by a hematopathologist for every case.

Interpretation

Report will include a morphologic description, a summary of the procedure, the percent positivity of selected antigens,

and an interpretive conclusion based on the correlation of the clinical history with the morphologic features and immunophenotypic results.

Cautions

Specimens will be initially triaged to determine which, if any, of the immunophenotyping panels should be performed.

Clinical Reference

1. Hanson CA, Kurtin PJ, Katzman JA, et al. Immunophenotypic analysis of peripheral blood and bone marrow in the staging of B-cell malignant lymphoma. Blood. 1999;94(11):3889-3896
2. Hanson CA. Acute leukemias and myelodysplastic syndromes. In: McClatchey KD, ed. Clinical Laboratory Medicine. Williams and Wilkins; 1994:939-969
3. Morice WG, Leibson PJ, Tefferi A. Natural killer cells and the syndrome of chronic natural killer cell lymphocytosis. Leuk Lymphoma. 2001;41(3-4):277-284. doi:10.3109/10428190109057982
4. Langerak, van Den Beemd, Wolvers-Tettero, et al. Molecular and flow cytometric analysis of the Vbeta repertoire for clonality assessment in mature TCRalphabeta T-cell proliferations. Blood. 2001;98(1):165-173. doi:10.1182/blood.v98.1.165
5. Hoffman RA, Kung PC, Hansen QP, Goldstein G. Simple and rapid measurement of human T lymphocytes and their subclass in peripheral blood. Proc Natl Acad Sci USA. 1980;77(8):4914-4917. doi:10.1073/pnas.77.8.4914
6. Jaffe ES, Cossman J. Immunodiagnosis of lymphoid and mononuclear phagocytic neoplasms. In: Rose NR, Friedman H, Fahey JD, eds. Manual of Clinical Immunology. 3rd ed. ASM Press; 1987:779-790
7. Morice WG, Kimlinger T, Katzmann JA, et al. Flow cytometric assessment of TCR-Vbeta expression in the evaluation of peripheral blood involvement by T-cell lymphoproliferative disorders: a comparison with conventional T-cell immunophenotyping and molecular genetic techniques. Am J Clin Pathol. 2004;121(3):373-383. doi:10.1309/3A32-DTVM-H640-M2QA
8. Stelzer GT, Shultz KE, Loken MR. CD45 gating for routine flow cytometric analysis of bone marrow specimens. Ann NY Acad Sci. 1993;677:265-280. doi:10.1111/j.1749-6632.1993.tb38783.x
9. Jevremovic D, Olteanu H. Flow cytometry applications in the diagnosis of T/NK-cell lymphoproliferative disorders. Cytometry B Clin Cytom. 2019;96(2):99-115. doi:10.1002/cyto.b.21768
10. Shi M, Jevremovic D, Otteson GE, Timm MM, Olteanu H, Horna P. Single antibody detection of T-cell receptor alpha beta clonality by flow cytometry rapidly identifies mature T-Cell neoplasms and monotypic small CD8-positive subsets of uncertain significance. Cytometry B Clin Cytom. 2020;98(1):99-107

Performance

Method Description

Flow cytometric immunophenotyping of peripheral blood is performed using the following antibodies:
Triage panel: CD3, CD10, CD16, CD19, CD34, CD45 and kappa and lambda surface light chains

Possible additional panels:
-B-cell panel: CD5, CD11c, CD20, CD22, CD23, CD38, CD103, and CD200
-T-cell panel: CD2, CD3, CD4, CD5, CD7, CD8, CD45, TRBC1 and gamma/delta T-cell receptors
-Killer-cell immunoglobulin-like receptor (KIR) panel: CD56, CD57, CD94, CD158a, CD158b, CD158e (p70), and NKG2a

-Acute panel: CD2, CD7, CD13, CD15, CD33, CD36, CD38, CD56, CD64, CD117, and HLA-DR
-B-cell ALL, minimal residual disease (MRD) panel: CD10, CD19, CD20, CD22, CD24, CD34, CD38, CD45, CD58, CD66c
-Myeloperoxidase/terminal deoxynucleotidyl transferase (MPO/TdT) panel: cytoplasmic CD3, CD13, cytoplasmic CD22, CD34, CD45, cytoplasmic CD79a, nuclear TdT, and cytoplasmic MPO
-Plasma cell panel: CD19, CD38, CD45, CD138, and cytoplasmic kappa and lambda light chains
-Sezary Panel: CD2, CD3, CD4, CD5, CD7, CD8, CD26, CD45 and TRBC1
(Keren P, McCoy Jr JP, Carey J. Flow Cytometry in Clinical Diagnosis. 4th ed. ASCP Press; 2007; Betters DM: Use of flow cytometry in clinical practice. J Adv Pract Oncol. 2015;6[5]:435-440. doi:10.6004/jadpro.2015.6.5.4)

PDF Report
No

Day(s) Performed
Monday through Friday, Sunday

Report Available
1 to 4 days

Specimen Retention Time
14 days

Performing Laboratory Location
Mayo Clinic Jacksonville Clinical Lab

Fees & Codes

Fees
- Authorized users can sign in to Test Prices for detailed fee information.
- Clients without access to Test Prices can contact Customer Service 24 hours a day, seven days a week.
- Prospective clients should contact their account representative. For assistance, contact Customer Service.

Test Classification
This test was developed using an analyte specific reagent. Its performance characteristics were determined by Mayo Clinic in a manner consistent with CLIA requirements. This test has not been cleared or approved by the US Food and Drug Administration.

CPT Code Information
88184-Flow cytometry; first cell surface, cytoplasmic or nuclear marker x 1
88185-Flow cytometry; additional cell surface, cytoplasmic or nuclear marker (each)
88187-Flow Cytometry Interpretation, 2 to 8 Markers (if appropriate)
88188-Flow Cytometry Interpretation, 9 to 15 Markers (if appropriate)
88189-Flow Cytometry Interpretation, 16 or More Markers (if appropriate)

LOINC® Information

Test ID	Test Order Name	Order LOINC® Value
LLPB	Leukemia/Lymphoma Immunopheno, B	In Process

Result ID	Test Result Name	Result LOINC® Value
JF001	Interpretation	69052-9