MAYO CLINIC LABORATORIES

Test Definition: CHRBM

Chromosome Analysis, Hematologic Disorders, Bone Marrow

Overview

Useful For

Assisting in the diagnosis and classification of certain malignant hematological disorders in bone marrow specimens

Evaluating the prognosis in patients with certain malignant hematologic disorders

Monitoring effects of treatment

Monitoring patients in remission

This test is **not recommended** for plasma cell neoplasms due to limited clinical utility.

Reflex Tests

Test Id	Reporting Name	Available Separately	Always Performed
_ML20	Metaphases, 1-19	No, (Bill Only)	No
_M25	Metaphases, 20-25	No, (Bill Only)	No
_MG25	Metaphases, >25	No, (Bill Only)	No
_STAC	Ag-Nor/CBL Stain	No, (Bill Only)	No

Testing Algorithm

This test includes a charge for cell culture of fresh specimens and professional interpretation of results. Analysis charges will be incurred for total work performed, which generally include 2 banded karyograms and the analysis of 20 metaphase cells. If no metaphase cells are available for analysis, no analysis charges will be incurred. If additional analysis work is required, additional charges may be incurred.

In addition to the cell culture without mitogens, a CpG-stimulated culture will be added and 10 additional cells will be analyzed for any specimen received from a patient age 30 or older with a reason for testing of chronic lymphocytic leukemia, small lymphocytic leukemia, lymphocytosis, Waldenstrom macroglobulinemia, or when test CLLDF / Chronic Lymphocytic Leukemia, Diagnostic FISH, Varies is ordered concurrently.

For more information see:
-Acute Leukemias of Ambiguous Lineage Testing Algorithm
-Acute Myeloid Leukemia: Testing Algorithm
-Acute Myeloid Leukemia: Relapsed with Previous Remission Testing Algorithm
-Acute Promyelocytic Leukemia: Guideline to Diagnosis and Follow-up
-B-Lymphoblastic Leukemia/Lymphoma Genetic Testing Guidelines
-Bone Marrow Staging for Known or Suspected Malignant Lymphoma Algorithm
-Multiple Myeloma: Laboratory Screening
-Myeloproliferative Neoplasm: A Diagnostic Approach to Bone Marrow Evaluation
-Mast Cell Disorder: Diagnostic Algorithm, Bone Marrow

-Eosinophilia: Bone Marrow Diagnostic Algorithm

Special Instructions

- Multiple Myeloma: Laboratory Screening
- Myeloproliferative Neoplasm: A Diagnostic Approach to Bone Marrow Evaluation
- Bone Marrow Staging for Known or Suspected Malignant Lymphoma Algorithm
- Acute Promyelocytic Leukemia: Guideline to Diagnosis and Follow-up
- B-Lymphoblastic Leukemia/Lymphoma Genetic Testing Guidelines
- Acute Leukemias of Ambiguous Lineage Testing Algorithm
- Acute Myeloid Leukemia: Testing Algorithm
- Acute Myeloid Leukemia: Relapsed with Previous Remission Algorithm
- Mast Cell Disorder: Diagnostic Algorithm, Bone Marrow
- Eosinophilia: Bone Marrow Diagnostic Algorithm

Method Name

Cell Culture without Mitogens followed by Chromosome Analysis

NY State Available

Yes

Specimen

Specimen Type

Bone Marrow

Ordering Guidance

If this test is ordered and the laboratory is informed that the patient is on a Children's Oncology Group (COG) protocol, this test will be canceled and automatically reordered by the laboratory as COGBM / Chromosome Analysis, Hematologic Disorders, Children's Oncology Group Enrollment Testing, Bone Marrow.

If this test is ordered concurrently with MDSDF / Myelodysplastic Syndrome (MDS), Diagnostic FISH, Varies, FISH testing will be held pending the results of this chromosome test. If the chromosome results are complete and informative, MDSDF will be canceled. MDS FISH testing is a second-tier test and should only be ordered if chromosome analysis is not successful, as it does not increase the sensitivity for detection of myelodysplastic syndrome (MDS) for classic abnormalities (ie, -5/5q-, -7/7q-). If a complete chromosome study is not achieved (<20 metaphases), MDS FISH testing will proceed. If an ambiguous abnormality (may include nonclonal abnormality or unresolved structural abnormality) is observed and targeted MDS probes could be useful in characterizing the abnormality, MDSDF test will be canceled and reordered with appropriate probes as MDSMF / Myelodysplastic Syndrome (MDS), Specified FISH, Varies.(1)

For plasma cell proliferative disorders such as multiple myeloma, fluorescence in situ hybridization (FISH) studies will detect chromosome anomalies with prognostic significance much more often than conventional chromosome studies. The recommended test in this situation is PCPDS / Plasma Cell Proliferative Disorder, High-Risk with Reflex Probes, Diagnostic FISH Evaluation, Bone Marrow. Due to limited clinical utility, chromosome analysis is **not recommended** for

plasma cell neoplasms.(2)

Shipping Instructions
Advise Express Mail or equivalent if not on courier service.

Necessary Information
1. A reason for testing should be submitted with each specimen. The laboratory will not reject testing if this information is not provided, but appropriate testing and interpretation may be compromised or delayed.
2. A pathology and/or flow cytometry report may be requested by the laboratory to optimize testing and aid in interpretation of results.
3. If a patient has received an opposite sex bone marrow transplant prior to specimen collection, note this information on the request.

Specimen Required
Container/Tube:
Preferred: Yellow top (ACD)
Acceptable: Green top (sodium heparin) or lavender top (EDTA)
Specimen Volume: 2 to 3 mL
Collection Instructions:
1. It is preferable to send the first aspirate from the bone marrow collection.
2. Invert several times to mix bone marrow.

Forms
If not ordering electronically, complete, print, and send a Hematopathology/Cytogenetics Test Request (T726) with the specimen.

Specimen Minimum Volume
See Specimen Required

Reject Due To
All specimens will be evaluated at Mayo Clinic Laboratories for test suitability.

Specimen Stability Information

Specimen Type	Temperature	Time	Special Container
Bone Marrow	Ambient (preferred)		
	Refrigerated		

Clinical & Interpretive

Clinical Information
Chromosomal abnormalities play a central role in the pathogenesis, diagnosis, and treatment monitoring of many hematologic disorders. Cytogenetic studies on bone marrow may be helpful in many malignant hematologic disorders as the observation of a chromosomally abnormal clone may be consistent with a neoplastic process.

Certain chromosome abnormalities may help classify a malignancy. For example, the Philadelphia (Ph) chromosome, also referred to as der(22)t(9;22)(q34;q11.2), is usually indicative of chronic myeloid leukemia (CML) or acute leukemia; t(8;21)(q22;q22) defines a specific subset of patients with acute myeloid leukemia; and t(8;14)(q24.1;q32) is associated with Burkitt lymphoma.

Cytogenetic studies are also used to monitor patients with hematologic neoplasia and may identify disease progression, such as the onset of blast crisis in CML, which is often characterized by trisomy 8, isochromosome 17q, and multiple Ph chromosomes.

Conventional chromosome studies of B-cell disorders are not always successful because B lymphocytes do not proliferate well in cell culture. The agent CpG 7909 (CpG) is a synthetic oligodeoxynucleotide that binds to the Toll-like receptor 9 (present on B cells, causing B-cell activation. In the laboratory setting, CpG may be used as a mitogen to stimulate B cells in patient specimens, thus allowing identification of chromosome abnormalities. CpG stimulation reveals an abnormal karyotype in approximately 80% of patients with chronic lymphocytic leukemia, and the karyotype is complex in 20% to 25% of cases. Several studies have reported that increased genetic complexity revealed by CpG-stimulated chromosome studies confers a less favorable time to first treatment, treatment response, and overall survival.

Reference Values

An interpretative report will be provided.

Interpretation

To ensure the best interpretation, it is important to provide some clinical information to verify the appropriate type of cytogenetic study is performed.

The following factors are important when interpreting the results:
-Although the presence of an abnormal clone usually indicates a malignant neoplastic process, in rare situations, the clone may reflect a benign condition.
-The absence of an abnormal clone may be the result of specimen collection from a site that is not involved in the neoplasm or may indicate that the disorder is caused by submicroscopic abnormalities that cannot be identified by chromosome analysis.
-On rare occasions, the presence of an abnormality may be associated with a constitutional abnormality that is not related to a malignant neoplastic process. Follow-up with a medical genetics consultation is recommended.
-On occasion, bone marrow chromosome studies are unsuccessful. If clinical information has been provided, there may be a fluorescence in situ hybridization study option that could be performed.

Cautions

Interfering factors:
Technical:
-Insufficient bone marrow specimen
-Use of an improper anticoagulant or improperly mixing the blood with the anticoagulant
-Clotted bone marrow specimen
-Excessive transport time
-Exposure of the specimen to extreme temperature

-Not processing the bone marrow as indicated before shipping the specimen
-Not sending the first aspirate from the patient's bone marrow collection

Biological:
-Abnormalities missed due to sampling error
-Subtle structural chromosome abnormalities may not be detected by conventional chromosome analysis
-Neoplastic cells either not dividing or not present in bone marrow

Clinical Reference

1. He R, Wiktor AE, Durnick DK, et al. Bone marrow conventional karyotyping and fluorescence in situ hybridization: Defining an effective utilization strategy for evaluation of myelodysplastic syndromes. Am J Clin Pathol. 2016;146(1):86-94. doi:10.1093/ajcp/aqw077
2. Mellors PW, Binder M, Ketterling RH, et al. Metaphase cytogenetics and plasma cell proliferation index for risk stratification in newly diagnosed multiple myeloma. Blood Adv. 2020;4(10):2236-2244
3. Dewald GW, Ketterling RP, Wyatt WA, Stupca PJ. Cytogenetic studies in neoplastic hematologic disorders. In: McClatchey KD, ed. Clinical Laboratory Medicine. 2nd ed. Williams and Wilkens; 2002:658-685
4. Rigolin GM, Cibien F, Martinelli S, et al. Chromosome aberrations detected by conventional karyotyping using novel mitogens in chronic lymphocytic leukemia with "normal" FISH: correlations with clinicobiological parameters. Blood. 2012;119(10):2310-2313
5. Swerdlow et al. WHO Classification of Tumours of Haematopoietic and Lymphoid Tissues. IARC Press:Lyon, 2017

Performance

Method Description

A cell count is performed on the specimen to establish a plating volume. Based on the cell count, a corresponding volume of bone marrow is added to 2 culture flasks containing culture medium and incubated. In the harvest process, the cells are exposed to colcemid and hypotonic solution and are then fixed. Metaphase cells are applied to microscope slides and stained by G-banding. Other staining methods are employed as needed. Twenty metaphases are usually examined. If a clone is suspected but not confirmed within 20 metaphases, 30 metaphases will be analyzed. Minimal evidence for the presence of an abnormal clone is defined as 2 or more metaphases with the same structural abnormality or chromosome gain (trisomy), or 3 or more metaphases lacking the same chromosome. All cells analyzed are captured using a computerized imaging system, and one or more karyograms from each clone are prepared to document the type of abnormality and to permit systematic interpretation of the anomalies.

When a specimen is received from a patient 30 years or older with a reason for testing noted as chronic lymphocytic leukemia, small lymphocytic lymphoma, lymphocytosis, or Waldenstrom macroglobulinemia, a CpG-stimulated culture will be added and 10 additional cells analyzed. Additional metaphases may be analyzed from the unstimulated or CpG-stimulated cell cultures if necessary to provide an accurate interpretation. All metaphases are captured using a computerized imaging system, and one or more karyograms from each clone are prepared to document the type of abnormality and to permit systematic interpretation of the abnormalities.(Arsham MS, Barch MJ, Lawce HJ. eds. The AGT Cytogenetics Laboratory Manual. 4th ed. Wiley-Blackwell, 2017)

PDF Report
No

Day(s) Performed
Monday through Friday

Report Available
9 to 11 days

Specimen Retention Time
4 weeks

Performing Laboratory Location
Mayo Clinic Laboratories - Rochester Main Campus

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 and its performance characteristics determined by Mayo Clinic in a manner consistent with CLIA requirements. It has not been cleared or approved by the US Food and Drug Administration.

CPT Code Information
88237, 88291-Tissue culture for neoplastic disorders; bone marrow, blood, Interpretation and report
88264 w/ modifier 52-Chromosome analysis with less than 20 cells (if appropriate)
88264-Chromosome analysis with 20 to 25 cells (if appropriate)
88264, 88285-Chromosome analysis with greater than 25 cells (if appropriate)
88283-Additional specialized banding technique (if appropriate)

LOINC® Information

Test ID	Test Order Name	Order LOINC® Value
CHRBM	Chromosomes, Hematologic, BM	81861-7

Result ID	Test Result Name	Result LOINC® Value
52358	Result Summary	50397-9
52360	Interpretation	69965-2
52359	Result	33893-9
CG774	Reason for Referral	42349-1

52361	Specimen	31208-2
52362	Source	31208-2
52364	Method	85069-3
52363	Banding Method	62359-5
54629	Additional Information	48767-8
52365	Released By	18771-6