MAYO CLINIC LABORATORIES

Test Definition: MSMRD

Myeloma Stratification and Risk-Adapted Therapy with Reflex to Measurable/Minimal Residual Disease, Bone Marrow

Overview

Useful For

Risk stratification of patients with treated multiple myeloma, which can assist in determining treatment and management decisions with reflex to measurable residual disease assessment for more sensitive analysis

Risk stratification of patients with newly diagnosed multiple myeloma

Reflex Tests

Test Id	Reporting Name	Available Separately	Always Performed
MPCDB	Probe, Each Additional (MPCDS)	No, (Bill Only)	No
CSMRT	MPCDS Pre-Analysis Cell Sorting, BM	No	No
MPCDS	mSMART Eval, PCPDs, FISH	Yes, (Order PCPDS)	No
MRDMR	Multiple Myeloma MRD by Flow, BM	Yes, (Order MRDMM)	No

Testing Algorithm

Based on the flow cytometric analysis and the presence of greater than or equal to 0.1% monotypic plasma cells, pre-analysis cell sorting and fluorescence in situ hybridization for plasma cell proliferative disorders may be performed at an additional charge.

Based on the flow cytometric analysis and the absence of monotypic plasma cells, then minimal residual disease for multiple myeloma may be performed at an additional charge.

Method Name

Flow Cytometry/DNA Content/Cell Cycle Analysis

NY State Available

Yes

Specimen

Specimen Type

Bone Marrow

Ordering Guidance

This test should be ordered on patients treated for multiple myeloma to confirm remission has been achieved, as an annual follow-up of those in remission or in uncertain remission.

Necessary Information

Include patient's disease state (untreated, treated, monoclonal gammopathy of undetermined significance, stable).

Specimen Required

Specimen Type: Redirected bone marrow
Preferred: Yellow top (ACD solution A or B)
Acceptable: Lavender top (EDTA)
Specimen Volume: 4 mL

Forms

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

Specimen Minimum Volume

3 mL

Reject Due To

Gross hemolysis	Reject
Fully clotted	Reject

Specimen Stability Information

Specimen Type	Temperature	Time	Special Container
Bone Marrow	Ambient (preferred)	72 hours	
	Refrigerated	72 hours	

Clinical & Interpretive

Clinical Information

Multiple myeloma is increasingly recognized as a disease characterized by marked cytogenetic, molecular, and proliferative heterogeneity. This heterogeneity is manifested clinically by varying degrees of disease aggressiveness. Multiple myeloma patients with more aggressive disease experience suboptimal responses to some therapeutic approaches; therefore, identifying these patients is critically important for selecting appropriate treatment options.

The Mayo algorithmic approach for stratification of myeloma and risk-adapted therapy classifies patients into either standard or high-risk categories based on the results of 2 assays: plasma cell proliferation and fluorescence in situ

hybridization for specific multiple myeloma-associated abnormalities.

Reference Values

Plasma cell clonality:
Normal bone marrow
No monotypic clonal plasma cells detected

DNA index:
Normal polytypic plasma cells
DNA index (G0/G1 cells): Diploid 0.95-1.05

Interpretation

The interpretation of results includes an overview of the results and the associated diagnostic, prognostic, and therapeutic implications.

Cautions

This test report is best used for patients treated for multiple myeloma to confirm remission has been achieved or as an annual follow-up of those in remission or in uncertain remission. It is designed for patients with multiple myeloma and may not be applicable for monoclonal gammopathy of uncertain significance, smoldering myeloma, or amyloidosis.

This stratification system is not meant to replace existing prognostic systems such as the International Staging System.

Clinical Reference

1. Gonsalves WI, Buadi FK, Ailawadhi S, et al. Utilization of hematopoietic stem cell transplantation for the treatment of multiple myeloma: a Mayo Stratification of Myeloma and Risk-Adapted Therapy (mSMART) consensus statement. Bone Marrow Transplant. 2019;54(3):353-367. doi:10.1038/s41409-018-0264-8
2. Kapoor P, Ansell SM, Fonseca R, et al. Diagnosis and management of waldenstrom macroglobulinemia: Mayo Stratification of Macroglobulinemia and Risk-Adapted Therapy (mSMART) guidelines 2016. JAMA Oncol. 2017;3(9):1257-1265. doi:10.1001/jamaoncol.2016.5763
3. Mikhael JR, Dingli D, Roy V, et al. Management of newly diagnosed symptomatic multiple myeloma: updated Mayo Stratification of Myeloma and Risk-Adapted Therapy (mSMART) consensus guidelines 2013. Mayo Clin Proc. 2013;88(4):360-376. doi:10.1016/j.mayocp.2013.01.019
4. Swerdlow S, Campo E, Harris NL, et al. WHO Classification of Tumours of Haematopoietic and Lymphoid Tissues. 4th ed. IARC Press; 2017. WHO Classification of Tumours, Vol. 2
5. Kumar SK, Rajkumar SV. The multiple myelomas-current concepts in cytogenetic classification and therapy. Nat Rev Clin Oncol. 2018;15(7):409-421 doi:10.1038/s41571-018-0018-y
6. Rajkumar SV, Landgren O, Mateos MV. Smoldering multiple myeloma. Blood. 2015;125(20):3069-3075 doi:10.1182/blood-2014-09-568899
7. Aljama MA, Sidiqi MH, Lakshman A, et al. Plasma cell proliferative index is an independent predictor of progression in smoldering multiple myeloma. Blood Adv. 2018;2(22):3149-3154
8. Mellors PW, Binder M, Ketterling RP, et al. Metaphase cytogenetics and plasma cell proliferation index for risk stratification in newly diagnosed multiple myeloma. Blood Adv. 2020;4(10):2236-2244
9. Sidana S, Jevremovic D, Ketterling RP, et al. Rapid assessment of hyperdiploidy in plasma cell disorders using a novel multi-parametric flow cytometry method. Am J Hematol. 2019;94(4):424-430

10. Ghosh T, Gonsalves WI, Jevremovic D, et al. The prognostic significance of polyclonal bone marrow plasma cells in patients with relapsing multiple myeloma. Am J Hematol. 2017;92(9):E507-E512

Performance

Method Description

Flow cytometric immunophenotyping of bone marrow is performed using the following antibodies: CD19, CD38, CD45, CD138, cytoplasmic kappa and lambda immunoglobulin, and DAPI (4',6-diamidino-2-phenylindole). Plasma cell clonality is detected through demonstrating CD38 and CD138 positivity along with immunoglobulin light chain restriction (ie, the presence of either predominately kappa or lambda immunoglobulin light chains) and abnormality of CD19 and/or CD45 expression. DNA index of clonal plasma cells and their proliferation activity is determined through staining of double-stranded DNA using DAPI.

Plasma cells (monoclonal/monotypic and polyclonal/polytypic) are detected by immunoglobulin light chain restriction, surface immunophenotype, and DNA content. If present, the light chain expressed by the monotypic plasma cells is indicated. The percentage of clonal plasma cells estimated by flow cytometry is affected by specimen processing and antigen loss with specimen aging. Manual differential counting remains the accepted standard for determining the bone marrow plasma cell percentage. The percentage of monotypic plasma cells in S-phase of the cell cycle is determined by quantitative DNA analysis. The DNA index is a calculated value. The presence of more than 1 value indicates the presence of cell populations with differing DNA contents within the monotypic plasma cells.(Dispenzieri A, Buadi F, Kumar SK, et al. Treatment of immunoglobulin light chain amyloidosis: Mayo Stratification of Myeloma and Risk-Adapted Therapy [mSMART] Consensus Statement. Mayo Clin Proc. 2015;90[8]:1054–1081. doi:10.1016/j.mayocp.2015.06.009)

Plasma Cell Proliferation
This test is performed using commercially available and laboratory-developed probes. Deletion or monosomy of chromosome 17, copy number gain of 1q, and additional copies of chromosomes 3, 7, 9, and 15 are detected using enumeration strategy probes. Translocations involving *IGH* are detected using dual-color, dual-fusion fluorescence in situ hybridization strategy probes. Rearrangement of *IGH* and *MYC* are detected using a break-apart strategy probe. For each probe set, 50 plasma cells (if possible) are scored and the result for each probe is reported. (Unpublished Mayo method)

Minimal Residual Disease:
Flow cytometric immunophenotyping for minimal residual disease of bone marrow is performed using the following antibodies:
Tube 1: CD138, CD27, CD38, CD56, CD45, CD19, CD117, and CD81.
Tube 2: CD138, CD27, CD38, CD56, CD45, CD19, cyKappa, and cyLambda.

Abnormal plasma cell populations are detected through demonstrating CD38 (multiepitope) and CD138 positivity along with immunoglobulin light chain restriction (ie, the presence of either predominately kappa or predominately lambda light chains) and abnormality of CD56, CD117, CD27, CD81, CD19 and/or CD45 expression. The percentage of clonal plasma cells estimated by flow cytometry is affected by specimen processing and antigen loss with specimen aging.

Minimal residual disease reporting is affected by sample volume and cellularity.(Unpublished Mayo method)

PDF Report
No

Day(s) Performed
Monday through Saturday

Report Available
1 to 13 days

Specimen Retention Time
14 days

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
88182-Flow cytometry, cell cycle or DNA analysis
88184-Flow cytometry; first cell surface, cytoplasmic or nuclear marker
88185 x 5-Flow cytometry; additional cell surface, cytoplasmic or nuclear marker (each)
88187-Flow cytometry interpretation, 2 to 8 Markers

LOINC® Information

Test ID	Test Order Name	Order LOINC® Value
MSMRD	mSMART with Reflex to MRD, BM	93363-0

Result ID	Test Result Name	Result LOINC® Value
CK056	Monotypic Plasma Cells:	93362-2
CK057	Monotypic PC per Total Events	93021-4

CK058	Monotypic Plasma Cells S-phase	93361-4
CK059	Monotypic Plasma Cells DNA Index	93360-6
CK060	Monotypic Plasma Cells DNA Ploidy	93359-8
CK061	Polytypic PC per Total Events	93358-0
CK062	Polytypic PC per All Plasma Cells	93020-6
616032	Final Diagnosis	22637-3