



23961 Craftsman Road, Suite E/F,
 Calabasas, CA 91302
 Tel: (818) 591-3030 Fax: (818) 591-8383
 onestep@rapidtest.com
 technicalsupport@rapidtest.com
 www.rapidtest.com

IVD See external label 2°C-8°C
 Σ=96 tests REF 1005-15

CK-MB
Microplate ELISA
Cat. No. 1005-15

Intended Use: The Quantitative Determination of Circulating Creatinine Kinase (MB-Isoform) Concentrations in Human Serum by a Microplate Immunoassay

SUMMARY AND EXPLANATION OF THE TEST

Creatinine kinase (CK) is an enzyme, found primarily in muscle and brain tissue, which exists as three dimeric isoenzymes — CKMM (CK-3), CK-MB (CK-2), and CK-BB (CK-1) — built from subunits designated M and B. The CK-MB isoenzyme, which has a molecular mass of approximately 87,000 daltons, accounts for 5 to 50% of total CK activity in myocardium. In skeletal muscle, by contrast, it normally accounts for just 1% or less, CK-MM being the dominant form, though the percentage can be as high as 10% in conditions reflecting skeletal muscle injury and regeneration (e.g. severe exercise, muscular dystrophy, polymyositis).²

Serial measurement of biochemical markers is now accepted universally as an important determinant in ruling in or ruling out acute myocardial infarction. CK-MB is one of the most important myocardial markers (in spite of not being altogether cardiac-specific), with well established roles in confirming acute myocardial infarction (AMI) and in monitoring reperfusion during thrombolytic therapy following AMI.²

In AMI, plasma CK-MB typically rises some 3 to 8 hours after the onset of chest pains, peaks within 9 to 30 hours, and returns to baseline levels within 48 to 72 hours.⁷ The pattern of serial CK-MB determinations is more informative than a single determination. One CK-MB measurement, even when taken at an appropriate time, cannot definitively confirm or rule out the occurrence of AMI. High levels might reflect skeletal injury rather than myocardial damage. A value within the reference range might be significant if it represents an increase from the patient's baseline levels. Accordingly it has been recommended that CK-MB be measured on admission to the emergency room, and at regulated intervals thereafter. The model described by Heart Emergency Room (ER) Program⁽¹³⁾ documented that serial testing for CK-MB isoenzyme (CK-MB, EC 2.7.3.2) mass on presentation and 3.6 and 9 hours later in patients with symptoms suggestive of acute ischemic coronary syndrome presenting with a non-diagnostic or equivalent electrocardiogram was more effective (100% sensitivity with 100% negative predictive value) than continuous serial electrocardiograms, electrocardiography and graded exercise testing.

In this method, CK-MB calibrator, patient specimen or control is first added to a streptavidin coated well. Biotinylated monoclonal and enzyme labeled antibodies (directed against distinct and different epitopes of CK-MB are added and the reactants mixed. Reaction between the various CK-MB antibodies and native CK-MB forms a sandwich complex that binds with the streptavidin coated to the well.

After the completion of the required incubation period, the enzyme-CK-MB antibody bound conjugate is separated from the unbound

enzyme-CK-MB conjugate by aspiration or decantation. The activity of the enzyme present on the surface of the well is quantitated by reaction with a suitable substrate to produce color.

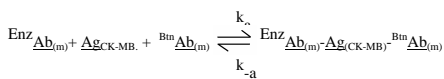
The employment of several serum references of known (CK-MB) levels permits the construction of a dose response curve of activity and concentration. From comparison to the dose response curve, an unknown specimen's activity can be correlated with CK-MB concentration.

PRINCIPLE

Immunoenzymometric assay:

The essential reagents required for an immunoenzymometric assay include high affinity and specificity antibodies (enzyme conjugated and immobilized), with different and distinct epitope recognition, in excess, and native antigen. In this procedure, the immobilization takes place during the assay at the surface of a microplate well through the interaction of streptavidin coated on the well and exogenously added biotinylated monoclonal anti-CK-MB antibody.

Upon mixing biotin labeled monoclonal antibody, the enzyme-labeled antibody and a serum containing the native antigen reaction results between the native antigen and the antibodies, without competition or steric hindrance, to form a soluble sandwich complex. The interaction is illustrated by the following equation:



$\overset{\text{B}^{\text{m}}\text{Ab}_{(\text{m})}}{\text{Ab}_{(\text{m})}}$ = Biotinylated Monoclonal Antibody (Excess Quantity)

$\text{Ag}_{\text{CK-MB}}$ = Native Antigen (Variable Quantity)

$\text{Enz } \overset{\text{B}^{\text{m}}\text{Ab}_{(\text{m})}}{\text{Ab}_{(\text{m})}}$ = Enzyme labeled MoAb (Excess Quantity)

$\text{Enz } \overset{\text{B}^{\text{m}}\text{Ab}_{(\text{m})}}{\text{Ab}_{(\text{m})}} - \overset{\text{Ag}_{\text{CK-MB}}}{\text{Ag}_{\text{CK-MB}}} - \overset{\text{B}^{\text{m}}\text{Ab}_{(\text{m})}}{\text{Ab}_{(\text{m})}}$ = Antigen-Antibodies complex

k_a = Rate Constant of Association

k_{-a} = Rate Constant of Dissociation

Simultaneously, the complex is deposited to the well through the high affinity reaction of streptavidin and biotinylated antibody. This interaction is illustrated below:



Strept.C.W. = Streptavidin immobilized on well

Immobilized complex = sandwich complex bound to the solid surface
 After equilibrium is attained, the antibody-bound fraction is separated from unbound antigen by decantation or aspiration. The enzyme activity in the antibody-bound fraction is directly proportional to the native antigen concentration. By utilizing several different serum references of known antigen values, a dose response curve can be generated from which the antigen concentration of an unknown can be ascertained.

PRECAUTIONS

For In Vitro Diagnostic Use
Not for Internal or External Use in Humans or Animals

All products that contain human serum have been found to be non-reactive for Hepatitis B Surface antigen, HIV 1&2 and HCV antibodies by FDA licensed reagents. Since no known test can offer complete assurance that infectious agents are absent, all human serum products should be handled as potentially hazardous and capable of transmitting disease. Good laboratory procedures for handling blood products can be found in the Center for Disease Control / National Institute of Health, "Biosafety in Microbiological and Biomedical Laboratories," 2nd Edition, 1988, HHS.

SPECIMEN COLLECTION AND PREPARATION

The specimens shall be blood serum in type and the usual precautions in the collection of venipuncture samples should be observed. For accurate comparison to established normal values, a fasting morning serum sample should be obtained. The blood should be collected in a plain red-top venipuncture tube without additives. Allow the blood to clot. Centrifuge the specimen to separate the serum from the cells. Centrifuging serum samples before a complete forms may result in the presence of fibrin. To prevent erroneous results due to the presence of

fibrin make sure that complete clot formation has taken place prior to the centrifugation of the samples.

Samples may be refrigerated at 2-8°C for a maximum period of two (2) days. If the specimen(s) cannot be assayed within this time, the sample(s) may be stored at temperatures of -20°C for up to 30 days. Avoid repetitive freezing and thawing. When assayed in duplicate, 0.100ml of the specimen is required.

REAGENTS AND MATERIALS PROVIDED:

1. CK-MB Calibrators – 1.0 ml/vial (Lyophilized) [A – F]

Six (6) vials of references for CK-MB antigen at levels of 0(A), 5.0(B), 25.0(C), 100.0(D), 200(E), and 400(F) ng/ml. Reconstitute each vial with 2.0ml of distilled or deionized water. The reconstituted calibrators are stable for 7 days at 2-8°C. In order to store for a longer period of time aliquot the reconstituted calibrators in cryo vials and store at -10°C. **DO NOT FREEZE THAW MORE THAN ONCE.** A preservative has been added.

Note: The calibrators, human serum based, were calibrated using gravimetric protein weight from a >99% purified preparation as seen with PAGE.

2. CK-MB Enzyme Reagent —13 ml/vial [Icon E]

One (1) vial containing enzyme labeled affinity purified antibody and biotin labeled monoclonal mouse IgG in buffer, dye, and preservative. Store at 2-8°C.

3. Streptavidin Microplate -- 96 wells – [Icon D]

One 96-well microplate coated with streptavidin and packaged in an aluminum bag with a drying agent. Store at 2-8°C.

4. Wash Solution Concentrate – 20 ml [Icon I]

One (1) vial containing a surfactant in buffered saline. A preservative has been added. Store at 2-30°C.

5. Substrate A --7.0ml/vial – [Icon S⁴]

One (1) bottle containing tetramethylbenzidine (TMB) in buffer. Store at 2-8°C.

6. Substrate B -- 7.0ml/vial – [Icon S⁸]

One (1) bottle containing hydrogen peroxide (H₂O₂) in buffer. Store at 2-8°C.

7. Stop Solution -- 8.0ml/vial - Icon STOP

One (1) bottle containing a strong acid (1N HCl). Store at 2-30°C.

8. Product Inert

Required But Not Provided:

- Pipette(s) capable of delivering 50µl and 100µl volumes with a precision of better than 1.5%.
- Dispenser(s) for repetitive deliveries of 0.100ml and 0.300ml volumes with a precision of better than 1.5% (optional).
- Microplate washer or a squeeze bottle (optional).
- Microplate Reader with 450nm and 620nm wavelength absorbance capability (The 620nm filter is optional)
- Adjustable volume (200-1000µl) repeat dispenser.
- Container(s) for mixing of reagents (see below).
- Absorbent Paper for blotting the microplate wells.
- Plastic wrap or microplate cover for incubation steps.
- Vacuum aspirator (optional) for wash steps.
- Timer.
- Storage container for storage of wash buffer.
- Distilled or deionized water.
- Quality Control Materials.

REAGENT PREPARATION:

1. Wash Buffer

Dilute contents of Wash Concentrate to 1000ml with distilled or deionized water in a suitable storage container. Store at room temperature 20-27°C for up to 60 days.

3. Working Substrate Solution

Pour the contents of the vial labeled Solution 'A' into the vial labeled Solution 'B'. Mix and store at 2-8°C. Use within 60 days. Or for longer periods of usage determine the amount of reagent needed and prepare by mixing equal portions of Substrate A and Substrate B in a suitable container. For example, add 1ml of A and 1ml of B per two (2) eight well strips (A slight excess of solution is made. Discard the unused portion).

Note: Do not use the working substrate if it looks blue.

TEST PROCEDURE

Before proceeding with the assay, bring all reagents, serum references and controls to room temperature (20 - 25 °C).

- Format the microplates' wells for calibrator, control and patient specimen to be assayed in duplicate. **Replace any unused microwell strips back into the aluminum bag, seal and store at 2-8°C.**
- Pipette 0.025 ml (25µl) of the appropriate calibrators, controls and samples into the assigned wells.
- Add 0.100 ml (100µl) of the CK-MB Enzyme Reagent to each well. **It is very important to dispense all reagents close to the bottom of the microwell.**
- Swirl the microplate gently for 20-30 seconds to mix. Cover with a plastic wrap.
- Incubate for 15 minutes at room temperature (20-25°C).
- Discard the contents of the microplate by decantation or aspiration. If decanting, tap and blot the plate dry with absorbent paper.
- Add 300µl of wash buffer (see Reagent Preparation Section), decant (tap and blot) or aspirate. Repeat two (2) additional times for a total of three (3) washes. **An automatic or manual plate washer can be used. Follow the manufacturer's instruction for proper usage. If a squeeze bottle is used, fill each well to the top by squeezing the container. Avoiding air bubbles. Decant the wash and repeat two (2) additional times.**
- Add 0.100 ml (100µl) of working substrate solution to all wells (see Reagent Preparation Section).
- Incubate at room temperature for fifteen (15) minutes.
- Add 0.050ml (50µl) of stop solution to each well and mix gently for 15-20 seconds. Read the absorbance in each well at 450nm (using a reference wavelength of 620-630nm to minimize well imperfections) in a microplate reader. **The results should be read within thirty (30) minutes of adding the stop solution.**

NOTE: Always add reagents in the same order to minimize reaction time differences between wells.

QUALITY CONTROL

Each laboratory should assay controls at levels in the low, normal and elevated ranges for monitoring assay performance. These controls should be treated as unknowns and values determined in every test procedure performed. Quality control trends should be maintained to monitor batch to batch consistency.

CALCULATION OF RESULTS

- Record the absorbance obtained from the printout of the microplate reader as outlined in Example 1
- Average the absorbance of each duplicate. Plot the mean absorbance for each duplicate calibrator versus the corresponding CK-MB concentration in ng/ml on linear graph paper.
- Draw a *Dose Response Curve (DRC)* using the best-fit through the plotted points.
- Interpolate the concentration of the controls and the unknowns from the DRC.
- The results are expressed in ng/ml.

EXAMPLE 1

| Sample ID. | Well Number | Abs (A) | Mean Abs (B) | Value (ng/ml) |
|------------|-------------|---------|--------------|---------------|
| Cal A | A1 | 0.022 | 0.022 | 0 |
| | B1 | 0.023 | | |
| Cal B | C1 | 0.072 | 0.071 | 5.0 |
| | D1 | 0.070 | | |
| Cal C | E1 | 0.243 | 0.236 | 25.0 |
| | F1 | 0.230 | | |
| Cal D | G1 | 0.851 | 0.833 | 100 |
| | H1 | 0.815 | | |
| Cal E | A2 | 1.503 | 1.504 | 200 |
| | B2 | 1.505 | | |
| Cal F | C2 | 2.567 | 2.612 | 400 |
| | D2 | 2.658 | | |
| Ctrl 1 | E2 | 0.046 | 0.049 | 2.35 |
| | F2 | 0.052 | | |
| Ctrl 2 | G2 | .598 | .592 | 70.3 |
| | H2 | .598 | | |
| Patient 1 | A3 | 0.140 | .136 | 12.4 |
| | B3 | 0.131 | | |

*The data presented in Example 1 is for illustration only and **should not** be used in lieu of a dose response curve prepared with each assay.

Quality Control:

In order for the assay results to be considered valid the following criteria should be met:

- The absorbance (OD) of calibrator 'A' should be ≤ 0.1 .
- The absorbance (OD) of calibrators 'F' should be ≥ 1.3 .
- Four out of six quality control pools should be within the established ranges.

LIMITATIONS OF PROCEDURE

- It is important that the time of reaction in each well is held constant for reproducible results.
- Pipetting of samples should not extend beyond ten (10) minutes to avoid assay drift.
- If more than one (1) plate is used, it is recommended to repeat the dose response curve.
- Addition of the substrate solution initiates a kinetic reaction, which is terminated by the addition of the stop solution. Therefore, the addition of the substrate and the stopping solution should be added in the same sequence to eliminate any time deviation during reaction.
- Plate readers measure vertically. Do not touch the bottom of the wells.
- Failure to remove adhering solution adequately in the aspiration or decantation wash step(s) may result in poor replication and spurious results.
- Highly lipemic, hemolyzed or grossly contaminated specimen(s) should not be used.
- Patient samples with CK-MB concentrations above 100 ng/ml may be diluted with the zero calibrator and re-assayed. Multiply the value obtained by the dilution factor to obtain the corrected value.
- Use components from the same lot. No intermixing of reagents from different batches.

EXPECTED VALUES

CK-MB values are consistently higher in plasma than in serum; thus, serum is preferred. Compared with fasting values in non-obese non-

diabetic individuals, CK-MB levels are higher in obese non-diabetic subjects and lower in trained athletes.

Each laboratory is advised to establish its own ranges for normal and abnormal populations. These ranges are always dependent upon locale, population, laboratory, technique and specificity of the method.

Based on the clinical data gathered by Diagnostic Automation, Inc. in concordance with the published literature the following ranges have been assigned. **These ranges should be used as guidelines only:**

Adult (Normal) 2.0 – 5.2 ng/ml

PERFORMANCE CHARACTERISTICS

A. Precision

The within and between assay precision of the CK-MB ELISA Microplate Test System were determined by analyses on three different levels of pool control sera. The number, mean value, standard deviation and coefficient of variation for each of these control sera are presented in Table 2 and Table 3.

TABLE 2

Within Assay Precision (Values in ng/ml)

| SAMPLE | N | X | σ | C.V. |
|--------|----|-------|----------|-------|
| Pool 1 | 20 | 0.82 | 0.07 | 8.53% |
| Pool 2 | 20 | 12.11 | 0.59 | 4.87% |
| Pool 3 | 20 | 58.10 | 3.74 | 6.44% |

TABLE 3

Between Assay Precision* (Values in ng/ml)

| SAMPLE | N | X | σ | C.V. |
|--------|----|-------|----------|-------|
| Pool 1 | 20 | 0.86 | 0.09 | 10.4% |
| Pool 2 | 20 | 13.31 | 1.22 | 9.16% |
| Pool 3 | 20 | 52.52 | 2.84 | 5.45% |

*As measured in ten experiments in duplicate over ten days.

B. Accuracy

The *Diagnostic Automation, Inc.* CK-MB Microplate ELISA was compared with a predicate radioimmunoassay assay. Biological specimens from population (symptomatic and asymptomatic) were used. (The values ranged from N/D – 86 ng/ml). The total number of such specimens was 124. The data obtained is displayed in Table 4.

TABLE 4

| Method | Mean (x) | Least Square Regression Analysis | Correlation Coefficient |
|-----------------|----------|----------------------------------|-------------------------|
| This Method (y) | 12.52 | $y = 0.5477 + 0.9946(x)$ | 0.995 |
| Reference (x) | 12.04 | | |

Only slight amounts of bias between the ELISA CK-MB system and the reference method are indicated by the closeness of the mean values. The least square regression equation and correlation coefficient indicates excellent method agreement.

C. Sensitivity

The sensitivity (detection limit) was ascertained by determining the variability of the 0 ng/ml serum calibrator and using the 2σ (95% certainty) statistic to calculate the minimum dose. The assay sensitivity was found to be 0.05 ng/ml.

D. Specificity

The cross-reactivity of the CK-MB ELISA method to selected substances was evaluated by adding the interfering substance(s) to a serum matrix at the following concentration(s). The antibody system used did not detect any CK-BB or CK-MM isoforms when tested at very high concentrations.

REFERENCES

- Adams JE, Schechtman KB, Landt Y, et al. Comparable detection of acute myocardial infarction by creatine kinase MB isoenzyme and cardiac troponin I. Clin Chem 1994;40:1291-5.
- Apple FS, Preese LM. Creatine kinase-MB: detection of myocardial infarction and monitoring reperfusion. J Clin Immunoassay 1994;17:24-9.
- Bhayana V, Cohoe S, Leung FY, et al. Diagnostic evaluation of creatine kinase-2 mass and creatine kinase-3 and -2 isoform ratios in early diagnosis of acute myocardial infarction. Clin Chem 1993;39:488-95. 4) Bruns DE.
- Diagnosis of acute myocardial infarction when skeletal muscle damage is present: a caveat regarding use of creatine kinase isoenzymes. Clin Chem 1989;35:705.
- Gibler WB, Lewis LM, Erb RE, et al. Early detection of acute myocardial infarction in patients presenting with chest pain and nondiagnostic ECGs; serial CK-MB sampling in the emergency department. Ann Emerg Med 1990;19:1359-66.
- Henderson AR, Stark JA, McQueen MJ, et al. Is determination of creatine kinase-2 after electrophoretic separation accurate? Clin Chem 1994;40:177-83.
- Kallner A, Sylven C, Brodin. U, et al. Early diagnosis of acute myocardial infarction; a comparison between chemical predictors. Scand J Clin Lab Invest 1989;49:633-9.
- Kiyasu Y. John. Current status of detecting CK-MB for patient management. Am Clin Prod Rev 1985;4:29-31.
- Lang H, Wuerzburg U. Creatine kinase, an enzyme of many forms. Clin Chem 1982;28:1439-47.
- Lee KN, Csako G, Bernhardt P, Elin RJ. Relevance of macro creatine kinase type 1 and type 2 isoenzymes to laboratory and clinical data. Clin Chem 1994;40:1278-83.
- Lee TH, Rouan GW, Weisberg MC, et al. Sensitivity of routine clinical criteria for diagnosing myocardial infarction within 24 hours of hospitalization. Ann Intern Med 1987;106:181-6.
- Panteghini M. Creatine kinase MB isoforms. J Clin Immunoassay 1994;17:30-4.
- Gibbler WB, Runyon JP, Levy RC, Sayre MR, Kacich R, Hattemar CR, et al. 'A rapid diagnostic and treatment center for patients with chest pain in the emergency department.' Ann Emerg Med 1995;25:1-8.



DIAGNOSTIC AUTOMATION, INC.
 23961 Craftsman Road, Suite E/F,
 Calabasas, CA 91302
 Tel: (818) 591-3030 Fax: (818) 591-8383
ISO 13485-2003

Revision Date: 4/6/06