***Clinical Chemistry**, Dr.C Collier, 533-2823*
***Emergency Department**, Dr. E Dagnone, 548-3599*
***Cardiology,** Dr. J McCans, 548-3802*

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Recommended Interpretations for Biochemical Cardiac Markers following presentation of patients with chest pain or equivalent

- Access **previous CK values** in electronic record to establish individual patient baseline.
- **Serial CK testing (**2-4 hours apart) is required if previous baseline result is not available.
- **cTnT** is preferably performed **on the second sample**, at least 4-6 hours after onset or maximum symptoms.
- Repeat testing with CKMB or cTnT is only indicated in complicated clinical situations.
- Diagnosis of **ACS and AMI remains a clinical decision**.

Serial CK or compared to baseline.	cTnT (ug/L)	Diagnostic Considerations
Rising (>20%)	>0.50	"**Consistent with acute myocardial infarction (AMI).**" Confirmatory testing is not indicated for patients with other definitive evidence of AMI. Monitor with serial CK.
	0.05 - 0.50	**"Consistent with myocardial injury."** AMI; other Coronary Syndromes (unstable angina, stable angina, minimal myocardial damage); CHF +/- ACS; Non-CAD cause of myocardial injury (sepsis, myocarditis, etc); renal disease (ESRD,CRF). Confirmatory testing is not indicated for patients with other definitive evidence of AMI.
	<0.05	**"No present evidence of myocardial injury."** Consistent with early AMI or increasing skeletal CK. Consider CKMB or repeat cTnT in 4 to 6 hours.
Decreasing, Flat, or Single time point	> 0.05	**"Consistent with recent or future adverse coronary event."** Late AMI; ACS; CHF +/- ACS; Non-CAD cause of myocardial injury; renal disease.
	< 0.05	**"No evidence of acute coronary event."** Repeat testing with biochemical markers is not indicated unless new symptoms develop.

CKMB interpretations: Negative (mass < 8 mg/L); Borderline (mass > 8 mg/L and Index 1.8 - 3.0 %); Positive (mass > 8 mg/L and I ndex > 3.0 %):

Troponins: Cardiac Troponin I (cTnI) and Cardiac Troponin T (cTnT)

Update, September 2001

Most of the literature and current presentations are very positive about troponin assays, with many implying that troponin can totally replace CKMB and that analysis of a small panel of tests at a single time point can make a definitive diagnosis in the Emergency Department. Unfortunately, like most things in life, this issue is not so simple! In fact, some institutions no longer differentiate between AMI and unstable angina, instead they diagnose ACS (acute coronary syndrome) in any patient with a positive troponin result. Below are the basic facts that we are currently using to inform our use of troponins.

Troponins are contractile proteins found in muscle. The assays for cardiac troponin detect only troponin released from cardiac muscle. They are thus "specific" for cardiac damage (ie, there are no false positives due to skeletal muscle damage and measurement of troponin from skeletal muscle).

In contrast, skeletal muscle trauma causes a significant elevation in both CK and CKMB. In these cases the CKMB Mass Index (%CKMB/CK) is used to help discern the etiology of the increase in CKMB and whether an AMI has occurred or not. It should be noted that since AMIs may be missed in these situations, cardiac troponins should be used instead.

The sensitivity and specificity of cTnI for AMI varies with the methodology of the assay, the upper reference limit, the time since the injury, and the method used to define myocardial infarction (e.g., gold standard).

The number of tissue and serum forms of cTnI, and their various time release profiles, is a story that is rapidly evolving at the present time. Different assays use different antibodies that have different cross-reactivities with these various forms. This may result in different "apparent" time profiles for the different assays.

The literature has variably reported that the cardiac troponins are detectable in the serum before, at the same time or after CKMB is detectable. Essentially, there is no significant difference in the detection time for these markers, with subtle differences being method dependant.

Myoglobin was introduced as an "early" marker for acute myocardial injury because theoretically a smaller marker should appear earlier in the serum than a larger marker. Since irreversible damage occurs after approximately 20 minutes of severe ischemia, and most patients present to the emergency department approximately 3 hours after the onset of pain, it is possible that many markers are starting to appear in the serum by this time. Population references ranges are often insensitive to significant individual changes in markers. As an AMI is an evolving event, we strongly recommend serial sampling at least two hours apart (for CK, MYO or CKMB), or at least 3 to 4 hours apart for the cardiac troponins (since their assays are currently less precise, it may take longer to detect a significant difference in serial results).

Cardiac troponin is not detectable in the serum of healthy individuals, and there is several fold more cardiac troponin than CKMB in cardiac tissue. These two attributes result in a more profound change in the concentration of cardiac troponin following an AMI (cTnI may change by 100 - 1000 fold, whereas CKMB changes by 10 - 100 fold).

Cardiac troponins tend to remain detectable in the serum longer than CKMB despite the fact that they are smaller molecules than CKMB. Their prolonged presence in serum may be due to circulation as complexes (troponin C,T,I complexes) or due to the release of troponin from a "deep" or bound pool in the muscle (ie, the original release from myocytes is probably from the cytosolic pool, while prolonged release is from the degradation of the thin filament).

There is not yet a definitive paper in the literature that demonstrates that cTnI remains elevated for 5-7 days in *all* patients, therefore a negative result cannot preclude a recent AMI with a 100% confidence.

If a patient presents with a decreasing total CK, cardiac troponin is the preferred test (LDH isoenzymes are now obsolete for this purpose).

cTnI is not affected by renal failure. Approximately 5% of patients with chronic renal failure demonstrate a consistent elevation in CKMB; in these patients cTnI is the test of choice for the diagnosis of AMI.

cTnT is positive in a significant number of patients with renal failure. The current belief is that this reflects "real" myocardial damage. The challenge is to determine if the myocardial injury is chronic or acute (ie AMI) and for this situation serial sampling for CK with cTnT or CKMB confimation may be necessary.

A recent pilot study of patients with renal failure at KGH indicated that only 30% had negative (<0.01 ug/L) baseline cTnT concentrations, however, >98% of patients had cTnTs <0.50 ug/L.

Troponins are "slightly" elevated in approximately 1/3 of patients with unstable angina (UA), and this group has a worse prognostic outcome over the next 1 to 12 months. It should be noted that if one was trying only to diagnose AMI, the specificity of troponin is less than CKMB because of its positivity in UA.

At the present time, the precision of the troponin assays is generally poorer those of the other cardiac markers. At cTnT concentrations of 0.04ug/L the imprecision is 10 -15%, while at 0.6 ug/L the imprecision is 5%. A result is considered significantly different from a previous result if it is different by more than 4 times the imprecision (ie at 95% confidence). In contrast, the imprecision of CK is <3% at all concentrations, and that of CKMB is <4%.