# SERUM TRANSAMINASE LEVELS IN THE DIAGNOSIS OF MYOCARDIAL INFARCTION

H. E. A. MENTZ, D.SC. (PRET.), A.R.I.C., *South African Institute for Medical Research*, and A. L. AGRANAT, M.D. (DUBL.), F.R.C.P. (EDIN.), D.T.M. & HY. (RAND), *Johannesburg*

Glutamic oxalacetic transaminase (GOT) and glutamic pyruvic transaminase (GPT) are widely distributed in the human body.[1] In comparison with the levels in the tissues, the normal serum levels of both enzymes (SGOT and SGPT) are very low. They are liberated into the blood in increased quantities on death of the cells in which they occur, and increased serum levels have been found following necrotic lesions in many different organs. Estimations of SGOT have been used most often in investigations of myocardial infarction and SGPT in liver-cell necrosis; the GPT content is greatest in liver tissue and less in heart muscle, and the increase in SGPT is thought by some to exceed that of SGOT in hepatic disorders.[2]

It has been reported that a raised SGOT level may confirm the diagnosis of myocardial infarction.[3-8] The level reaches a peak which may be 15 times higher than normal within 24 - 48 hours, and returns to normal by the 4th - 7th day.

It has been suggested that with relatively small infarcts the peak level may be within or at the upper limit of the accepted normal range, especially if a patient's serum transaminase in health is in the low range of normal; for this reason serial determinations should be carried out.

Sometimes it is difficult to distinguish on the electrocardiogram (ECG) between coronary insufficiency (ischaemia) and limited infarction. The SGOT level should be of diagnostic help in such cases, since it was found to remain unaltered if ischaemia is not accompanied by necrosis.[9] Dewar *et al.*[7] found that the enzyme estimation is complementary to, but not necessarily more reliable than, the ECG in showing whether necrosis has taken place.

The SGOT level may also be of special value in complicated infarction. A second infarction will give a secondary peak, even though the ECG does not change.[2,6,7] Also, in some patients with previous infarction, the ECG can be so distorted that on a single initial tracing alone it may be impossible to deduce with certainty that fresh infarction has occurred. According to Keele *et al.*[8] anginal pain at rest with an abnormal, but not diagnostic, ECG associated with a raised SGOT concentration, carries the same prognostic significance as does the electrocardiographically proved infarction, while the transaminase level does not tend to be raised with chest pain from most other causes.

In this investigation we attempted to answer the following questions:

1. When is the SGOT estimation of help in the diagnosis of myocardial infarction?
2. What are the minimum number of tests required in a single case?
3. What additional information can the SGPT estimation supply?

The answers to the questions are important. If they are known, the test need not be done unnecessarily, the number of tests may be reduced to a minimum, and the interpretation of the test may be properly assessed.

*Method of Investigation*

Two groups of patients were investigated on a fairly uniform basis. Apart from 6 patients treated in the Johannesburg General Hospital, all the patients were admitted to a nursing home where they were under the personal care of one of us (A.L.A.). Electrocardiograms were done and repeated where necessary. The SGOT and SGPT levels were estimated daily for 10 consecutive days and the values were correlated with the clinical findings. In order to reduce the transaminase estimations to a practical number, the SGOT and SGPT levels were assessed in most cases for the first 4 days in each of the series. These values represent 4 daily consecutive levels in blood collected on admission, and as soon after the episode of chest pain as possible. To prolong this investigation to 6 - 10 consecutive days makes the test, in our opinion, impracticable in most instances. In fact, if a single diagnostic level should be positive, no more estimations need be done.

*Methods Used for Transaminase Estimations and Normal Values*

SGOT and SGPT levels were estimated according to the method of King.[10]

In a series of 36 normal adult males and females the SGOT level was between 18 and 100 units, and the SGPT level between 18 and 89 units. This is in accordance with the normal figures reported by King.

## RESULTS

*Group A*

In this group, which consisted of 20 patients, the diagnosis of myocardial infarction could be made clinically and on ECG evidence. Daily transaminase tests were carried out to assess their value.

In 16 of the 20 patients, positive ECG evidence and positive transaminase levels were obtained. In 4 patients the SGOT values failed to reach diagnostic levels. Significantly, these 4 were patients with subendocardial necrosis, as demonstrated by the electrocardiograms. Presumably the liberation of GOT into the blood stream may be related to quantitative necrosis of heart muscle. The 4 cases are briefly quoted:

1. *S.L.F., female, aged 50 years* — admitted with a typical attack of myocardial infarction. The ECG showed a posterior infarction. The SGOT levels for the first 3 consecutive days were 50, 50, and 40 units per 100 ml.
2. *J.H.S., male, aged 52 years* — admitted with a severe attack of substernal pain. The ECG showed a subendocardial infarction. For the first 3 consecutive days the SGOT levels were 29, 90 and 55 units. A steep rise or fall in the SGOT levels in the region below the diagnostic level is considered significant by some authors; however, it is apparent that the ECG evidence was more important than the SGOT levels in this case.
3. *H.T., female, aged 52 years* — the description of pain on admission was suggestive of myocardial infarction. The electrocardiograms showed a subendocardial infarction. The SGOT levels for the first few days ranged from 50 to 75 units per 100 ml.
4. *O.R.S., male, aged 55 years* — chest pain was typical of myocardial infarction. Serial electrocardiograms showed a subendocardial infarction. The SGOT levels ranged from 40 to 70 units per 100 ml.

These results show that the transaminase test may be unnecessary if the diagnosis of myocardial infarction can be confirmed by a positive ECG. It is also significant to note that in 4 cases of subendocardial infarction the SGOT concentrations did not reach diagnostic levels. In case 2, a steep gradient occurred below the accepted diagnostic level — this may have indicated a small infarction.

On the whole, the SGPT levels obtained were lower than the corresponding SGOT levels.

*Group B*

This group was made up of 20 patients with suspected or recurrent myocardial infarction.

The transaminase test is important in these cases. As already mentioned, no further tests are as a rule necessary if the ECG is unequivocally positive for myocardial infarction. However, where atypical pain occurs without confirmatory clinical or ECG evidence, these tests have their greatest value. For practical purposes the test need not be applied to this group in general; it is only when doubt exists that the transaminase tests are needed.

The following are examples of some situations where the test was of help:

*Case 1. Recurrent myocardial infarction.* Male, aged 42 years — admitted with paroxysmal fibrillation and a history of previous myocardial infarction. The patient had chest discomfort, but no severe pain. The SGOT level was 140 units per 100 ml. Recurrent infarction was diagnosed, which was later supported by a changing pattern in the ECG.

*Case 2. Attacks of paroxysmal fibrillation and substernal pain for 10 minutes in a patient with a previous myocardial infarction.* Male, aged 51 years — he was distressed, with a feeling of tightness in the chest, and dyspnoea. The SGOT levels ranged from 65 to 70 units. Electrocardiograms showed a normal rhythm and an old myocardial-infarction pattern. There was probably no recurrence of infarction.

*Case 6. Recurrent chest pain with bundle branch block from preceding myocardial infarction.* Male, aged 55 years — there was previous myocardial infarction with residual left bundle-branch block, and the electrocardiograms were unchanged after recurrent bouts of chest pain. The SGOT level was 160 units and a diagnosis of recurrent infarction was made.

*Case 7. Recurrent 'attack' from 'food poisoning' resembling previous myocardial infarction.* Male, aged 55 years — he had a previous myocardial infarction and the ECG also showed an old myocardial-infarction pattern. He had recurrence of severe upper abdominal and lower substernal pain with sweating, vomiting and diarrhoea, and was shocked. The blood pressure fell from 190/110 to 110/90 mm.Hg. The patient ascribed the symptoms to 'food poisoning', but clinically the diagnosis was strongly in favour of a recurrent infarction. Three consecutive SGOT tests showed levels of 50, 70 and 40 units, which meant that the patient's diagnosis was correct.

*Case 13. Previous angina pectoris, admitted with severe substernal pain.* Female, aged 50 years — the patient was a very anxious type of person. The ECG was normal and the SGOT levels ranged from 50 to 70 units. Myocardial infarction was excluded.

*Case 16. Short period of severe substernal pain followed by a 'blackout' in a patient with recent myocardial infarction.* Male, aged 34 years — shortly after an attack of myocardial infarction the patient was admitted with the above symptoms. Clinically there was no shock. The ECG showed an extensive anterior myocardial-infarction pattern similar to that of the previous record. He recovered rapidly. The SGOT values ranged from 45 to 83 units, which excluded recurrence of myocardial infarction.

The following are examples of some situations where the test was of no help:

*Case 4. Where the test is done more than 3 days after an acute episode.* Male, aged 55 years — he had myocardial infarction 3 years previously, and had received long-term anticoagulant therapy since then. He had a sudden recent 'collapse' with diarrhoea and vomiting and was unconscious, but did not have pain. His blood pressure fell from 160/105 to 105/60 mm.Hg. Serial electrocardiograms showed an old myocardial-infarction pattern. The SGOT level, which could only be done 5 days later, was 85 units. Clinically the diagnosis was assessed as re-infarction. The SGOT test had probably lost its value on account of the 5-days' time lag.

*Case 11. Where the ECG evidence takes preference to the transaminase test on absence of typical clinical features of myocardial infarction.* Male, aged 49 years — he had typical anginal pain and there were slight ischaemic changes on the ECG at rest. Exercise produced a typical pattern of acute posterior myocardial infarction, but without prolonged pain or shock. The daily sequence of the SGOT levels for 9 days was 95, 20, 20 - 65 - 50 units. The SGPT levels were all lower. The SGOT concentration did not reach a diagnostic level of more than 100 units, although the significance of the steep fall from 95 to 20 could not be discarded. Subsequent electrocardiograms confirmed a posterior myocardial infarction. In this case the ECG showed myocardial infarction before any conclusions could be drawn from the transaminase tests.

*Where extraneous pathology nullifies the value of the transaminase test — cases 14, 15 and 17.*

*Case 14.* Male, aged 34 years — he had severe substernal pain a week before admission. The ECG was normal at rest, but showed significant ST depression after exercise. Chest pain occurred during the last week of a six-week period of bed rest for infectious hepatitis. For 10 days the SGOT values ranged from 290 to 440 units. The SGPT values ranged from 460 to 500 units. Liver-function tests showed gross hepatocellular damage.

Subsequent electrocardiograms confirmed the diagnosis of coronary ischaemia and not that of myocardial infarction. In such a case, therefore, the transaminase test can be of no help.

*Case 15.* Female, aged 61 years — she had severe substernal pain on admission, with a history of several preceding attacks of myocardial infarction. She presented with a clinical picture of myocardial infarction, but the ECG was normal. The SGOT level on admission was 500 units, which was difficult to fit in with a normal ECG.

For the next 6 days the SGOT levels ranged from 190 to 500 units, while the SGPT curve was even higher and more sustained, with levels ranging from 320 to 470 units.

Four subsequent electrocardiograms during convalescence were normal, except for a mild ischaemic pattern on exercise. When we heard that the patient had had a previous cholecystogram, we performed a cholangiogram which showed an obstructive process at the ampulla of Vater with dilatation of the common duct. Liver-function tests and serum-amylase levels were normal. A barium meal and a X-ray of the chest did not show any abnormalities. As the case developed a diagnosis of myocardial infarction could not be sustained. This most likely also applied to the preceding occasions when myocardial infarction was diagnosed. The extraneous pathology here was an acute cholangitis with obstruction of the common bile duct, resembling myocardial infarction symptomatically. The SGOT levels may have been misleading at the onset, but this impression was soon corrected. A point of note here is that the SGOT values seldom reach these very high levels in myocardial infarction.

*Case 17.* Male, aged 52 years — on the second day after a cholecystectomy the patient complained of anterior chest pain and then 'collapsed'. He was pulseless, dyspnoeic, and cyanosed, while the chest was full of bubbling râles. Intravenous 'levophed' was then given. On the following day the electrocardiogram suggested a myocardial-infarction pattern (biphasic T waves but no ST displacement) in $V_3$ and $V_4$. Clinically, a postoperative myocardial or pulmonary infarction was suspected, but the ECG showed no evidence of acute cor pulmonale. An X-ray of the chest showed pulmonary infarction. A second ECG was again compatible with a small anterior myocardial infarct. The SGOT levels during the first 3 days ranged from 150 to 195 units, while the SGPT levels ranged from 160 to 290 units. After a week the transaminase tests were repeated; for 4 days the SGOT levels ranged from 125 to 150 units and the SGPT levels from 205 to 270 units. An extracardiac cause is usually suggested when the SGPT curve is higher than the SGOT curve, and the sustained high levels of both enzymes also support an extracardiac cause. A third ECG was normal.

The 'collapse' and ECG evidence of myocardial infarction suggested that this was the predominant pathology. The extraneous pathology (pulmonary infarction with bronchopneumonia) nullified the value of the SGOT test.

The SGPT levels were invariably lower than the SGOT levels in those cases where no mention has been made of the SGPT values.

## DISCUSSION

From a study of these cases certain points emerge which are of importance in assessing the value of the test.

When the clinical findings and ECG are diagnostic of myocardial infarction, there is no necessity to do the transaminase test. The electrocardiographic evidence is in general far more important than the transaminase tests. These may only confirm the diagnosis where it is already established.

In Group A the transaminase tests were done to study their significance in known cases of myocardial infarction. Another 20 patients were studied in Group B, which included the 'problem cases' where a straightforward ECG in most cases could not prove the diagnosis of myocardial infarction without discussion.

The SGOT level exceeded the diagnostic level of 100 units within the first 3 days in most cases of myocardial infarction. It did not reach a diagnostic level in 4 cases of subendocardial infarction which were proved by electrocardiograms. A steep gradient in the subdiagnostic zone may be significant, but this has not been definitely proved.

The SGOT estimations were usually of little value after the first 3 days following a myocardial infarct. A later rise, without recurrence of chest pain, could usually be ascribed to some extracardiac cause.

For the diagnosis of myocardial infarction, the SGPT estimations were of no additional value.

When a raised SGOT level is accompanied by an even higher level of SGPT, it is usually, but not always, a sign of an extracardiac cause. Very high SGOT levels, e.g. 400 - 500 units, were seldom found in cases of myocardial infarction. For differential diagnostic purposes both tests should be done. When the levels for both SGOT and SGPT remain sustained for 7 days or more, the tests usually indicate an extracardiac cause, with or without an associated myocardial infarct.

When an electrocardiogram is unobtainable, 3 consecutive daily SGOT tests should be of considerable value in confirming a clinical diagnosis. This applies in particular to doctors practising in an area where an ECG is not available.

## SUMMARY

A clinical trial was undertaken to assess the indications, value, and limitations of the serum-transaminase tests in the diagnosis of myocardial infarction. It was concluded that:

1. The transaminase tests are unnecessary if the ECG is diagnostic of myocardial infarction.
2. In general, the tests are required in only a limited number of cases, usually only in those cases where the ECG is equivocal.
3. The SGOT values may not reach diagnostic levels in cases of subendocardial infarction.
4. The SGOT value usually reaches a diagnostic level within the first 3 - 4 days of an episode of myocardial infarction. A secondary rise without recurrence of chest pain is probably no proof of recurrent myocardial infarction.
5. Very high SGOT levels, e.g. 400 - 500 units, are seldom found in pure myocardial infarction. These usually indicate extracardiac pathology, especially when accompanied by even higher SGPT levels, and when both levels are sustained for a period of 7 days or more.
6. The SGPT estimations were of no additional help in the diagnosis of myocardial infarction.
7. To confirm a diagnosis of myocardial infarction, serial SGOT estimations should be of considerable value

to doctors practising in an area where an ECG is not available.

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