Scand J Clin Lab Invest 1993; 53: 667–670

A simplified method to determine galactose elimination capacity in patients with liver disease

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Bergström M, Söderman C, Eriksson LS. A simplified method to determine galactose elimination capacity in patients with liver disease. Scand J Clin Lab Invest 1993; 53: 667–670

Galactose elimination capacity (GEC) is one of the most widely used liver function tests. It is relatively simple but still involves a number of capillary blood samples and is therefore fairly expensive. In the current study we present a simplified formula, based on GEC investigations in 103 cirrhotic patients, with which it is possible to estimate the GEC with one or two blood samples. Using this formula: GEC = [7.422—corrected B-galactose$^{60\,min}$]/4.575, we could accurately predict GEC in 24 additional patients.

Key words: albumin; cirrhosis; liver function tests

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The prediction of prognosis in patients with cirrhosis is a difficult but important problem. Various dynamic liver function tests have been tried [1, 2]. One of the more widely used tests is the galactose elimination capacity (GEC) [3, 4]. Although, the practical procedure of this test is simple, it involves capillary blood sampling every fifth minute between 25 and 60 min after the administration of galactose, thus occupying laboratory personnel for more than 1 h. In the present study we have tried to further simplify the GEC method, to reduce the number of blood samples and the time needed for laboratory staff and, consequently, minimize the costs for the procedure.

PATIENTS AND METHODS

Patients

One hundred and twenty-seven patients with chronic liver disease, 60 men and 67 women (mean age 48 ± 1 years) were investigated. Thirty-five patients had primary biliary cirrhosis (PBC), 23 chronic active hepatitis, 26 alcoholic cirrhosis, 20 primary sclerosing cholangitis and 23 had various diagnoses such as cryptogenic cirrhosis and Budd-Chiaris syndrome.

Procedure

The GEC-test was performed in the morning, after an overnight fast. Galactose (500 mg kg^{-1} body weight) was infused intravenously for 5 min. Capillary samples were taken every fifth minute from 25–60 min after start of the infusion [5]. In 31 patients the urinary galactose elimination was determined. The patients were asked to urinate before and after the end of the test and galactose concentration was analysed in the collected urine.

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Analyses

Blood and urine galactose concentrations were determined using a commercial reagent kit based on galactose dehydrogenase and UV-spectrophotometry (Test-Combination Galactose, Boehringer Mannheim, Germany). GEC values were expressed as mmol galactose eliminated per minute and square metre body surface area (BSA). The reference value for GEC is $> 1.00\,\text{mmol}\cdot(\text{min}\cdot\text{m}^2)^{-1}$.

Standard statistical methods were employed using linear regression analyses when applicable. Data in the text and figure are presented as mean ± SEM.

RESULTS

The urinary loss of galactose, determined in 31 patients, was compared to the approximated loss of 10% of the administered dose, as suggested by Tygstrup [6]. GEC values calculated by this procedure correlated well with values based on urinary galactose analyses ($r = 0.980$, $p < 0.001$). Thus, the urinary handling and determination of galactose could be eliminated by approximating a loss of 10% of the administered dose in the urine.

A further way to simplify the determination of GEC is illustrated in Figure 1. In 103 patients blood galactose concentrations at 60 min after start of infusion were adjusted to a dose of $100\,\text{mmol}\,\text{m}^{2^{-1}}$ body surface area [$\text{B-galactose}^{60\,\text{min}}\cdot 100\cdot(\text{dose/BSA})^{-1}$]. These arbitrarily corrected values showed good correlation to GEC values ($r = 0.905$, $y = 7.422 - 4.575x$). Galactose concentrations obtained at earlier points after the infusion did not correlate as well as the 60 min value. This was probably due to variations in infusion time and galactose distribution, which makes the early values less reliable. In this group of 103 patients, GEC calculated from one blood sample could correctly classify 93% of the tests as normal or pathological, when compared to the measured

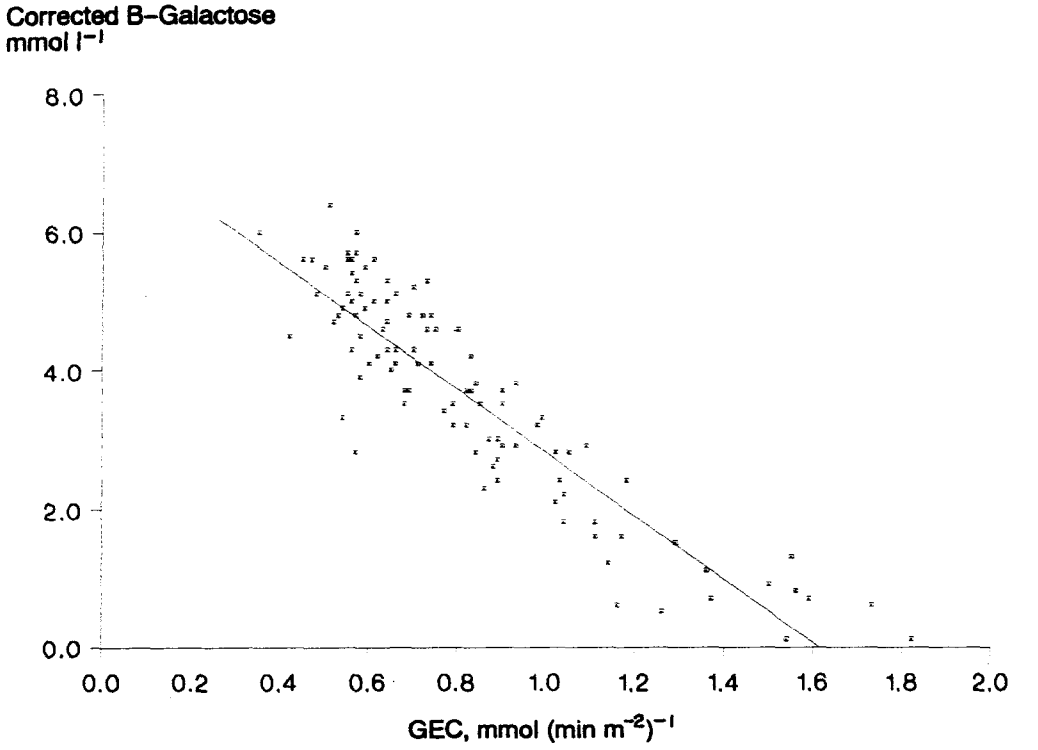

FIG. 1. Correlation between GEC measured and the adjusted 60 min galactose concentration in the large group of 103 patients.

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GEC test. From this the following formula for estimating GEC was determined:

$$GEC = [7.422 - \text{corrected B-galactose}^{60\,min}]/4.575$$

where corrected B-galactose = B-galactose $^{60\,min} \cdot 100 \cdot (dose/BSA)$.

To validate this formula GEC was determined in 24 consecutive patients. The measured GEC value was compared to the value calculated from the corrected 60 min galactose concentration. The result is seen in Figure 2. A good correlation existed between the measured and calculated GEC values ($r = 0.863$; $p < 0.001$).

Using this calculation, the GEC test can be modified to one capillary sample 60 min after the start of infusion.

DISCUSSION

The present study demonstrates that the GEC can be determined with sufficient accuracy from a limited number of blood samples. We would suggest three samples, taken in rapid succession at 60 min. This minimizes the time needed for laboratory personnel and the cost for the procedure is reduced.

The value of galactose elimination has recently been discussed in several studies. While some studies have demonstrated that no significant prognostic information could be found with regard to death or deterioration of liver function in cirrhotic patients [7, 8] others have described the GEC as an important part in the assessment of patients for liver transplantation [9]. Prediction of survival is difficult in patients with liver disease and may explain the diverging opinions on GEC as a marker of liver function. Complications such as variceal bleeding and hepatocellular cancer can develop also in cirrhosis with moderate hepatic dysfunction and are important causes of death. One group in which GEC might be of special interest is patients with malnutrition as a part of their chronic liver disease such as patients with PBC and primary sclerosing cholangitis. In these patients albumin and prothrombin time may be altered due to deficiency and bile salt malabsorption while the

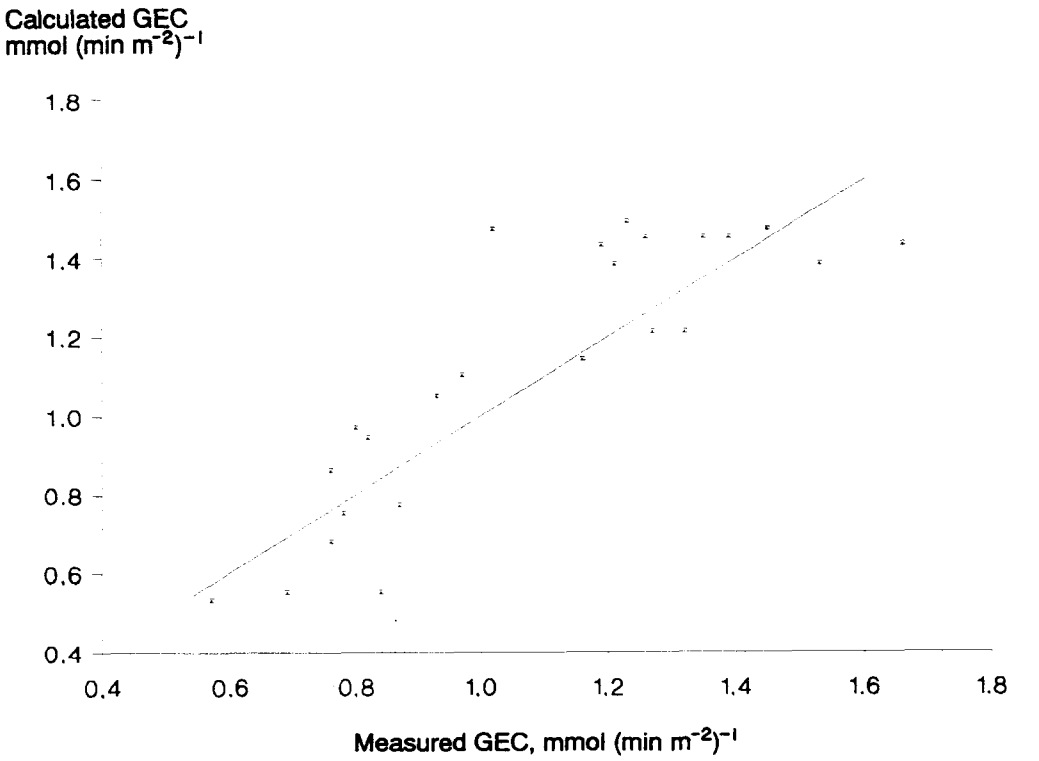

FIG. 2. Correlation between measured and calculated GEC in 24 prospective patients.

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liver function may be less deranged. In these patients the simplified GEC test, presented here, could be used as an additional test to the ordinary 'liver function' variables.

The cheaper test would also be of value in serial determinations in the follow-up of patients with liver disease.

ACKNOWLEDGMENT

This study was supported by the Swedish Medical Research Council.

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Received: 1 June 1992
Accepted: 10 January 1993

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