EVALUATION OF THE GURD TEST FOR FAT EMBOLISM

W. J. NOLTE, T. OLOFSSON, T. SCHERSTÉN and D. H. LEWIS, GÖTEBORG, SWEDEN

From the Departments of Surgery I and II and Anesthesiology I, Sahlgrenska Sjukhuset, Göteborg

In clinical work there is an obvious need for a test to aid in the diagnosis of fat embolism. Recently Gurd (1969, 1970, 1972) described a new test, which was said to be specific and to allow both a qualitative and a quantitative assessment of circulating fat globules. However, using this test in clinical work we were not convinced of its specificity. For this reason we found it important to perform a more detailed evaluation of the reliability of the test.

METHODS AND MATERIAL

Blood samples of 10 millilitres were taken from the patients, allowed to clot and then centrifuged at 3,500 r.p.m. for ten minutes. Serum was pipetted off and after careful mixing divided into two portions. The first portion was kept for determination of triglycerides. From the second portion a sample of 2 millilitres was passed through a microfilter (Millipore microfilter: pore size 8 microns; 2.5 centimetres in diameter). The filtrate was kept for determination of the retained amount of triglycerides. Several methods were used to stain and visualise the fat droplets on the filter. Sudan III, using the method described by Romeis (1948), was found to be the best. The filter was then examined under the microscope and visible fat droplets were counted.

TABLE I

<table>
<thead>
<tr>
<th>Number of patients</th>
<th>Number of tests</th>
<th>0</th>
<th>(+)</th>
<th>+</th>
<th>++</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>41</td>
<td>63</td>
<td>36</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Group B</td>
<td>10</td>
<td>19</td>
<td>11</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Group C</td>
<td>4</td>
<td>34</td>
<td>18</td>
<td>4</td>
<td>10</td>
</tr>
</tbody>
</table>

The filter paper was stained with Sudan III and fat globules counted under the microscope. (× 125).

0 denotes no visible fat droplets.
(+ ) denotes less than five.
+ denotes between six and twenty.
++ denotes more than twenty.

Triglycerides were determined according to the method described by Carlson and Wadström (1959).

The clinical material comprised three groups of patients: Group A comprised forty-one healthy volunteers and patients awaiting elective operations; Group B comprised seventy-one patients with fractures, but without symptoms of fat embolism; Group C comprised seven patients with clinical evidence of fat embolism. All these patients had severe or multiple fractures, severe post-traumatic respiratory insufficiency and symptoms of affection of the central nervous system. Five of them had to be treated in a respirator for variable periods. Four died after three to twenty days. Necropsy showed pulmonary fat embolism in all of these patients.
RESULTS

In the first part of this study only the filtration of the serum and staining of the filter-paper were performed. In the second part, in addition, the triglycerides in serum, in filtrate and on the filter were determined. Table I shows the results of this part of the study. A nearly even distribution of positive and negative tests was found in the three groups of patients.

In Figure 1 the concentration of triglycerides in serum is plotted against the concentration in the filtrate of the same sample. The broken line is the line of identity. A bivariate regression analysis revealed a nearly identical function for all three groups of patients. Moreover, the line of identity is within the confidence limits of all three populations.

The differences in triglyceride concentration between serum and filtrate were not statistically significant.

FIG. 1
Triglyceride concentration in serum plotted against the triglyceride concentration in the filtrate after microfiltration (pore size 8 microns). The broken line is the line of identity.

In Group A the mean difference was $11.5 \pm 15.4$ milligrams triglyceride per 100 millilitres. In Group B $30.3 \pm 21.6$ and the corresponding value in Group C was $9.7 \pm 17.6$ milligrams triglycerides per 100 millilitres.

Figure 2 shows the triglyceride content of the filter plotted against the serum concentration. In Group C there was a significant correlation between these two parameters. In the two other groups of patients no such correlation was found. In most cases the amount of triglyceride on the filter was very low. Furthermore, there were remarkable variations at corresponding serum values.

DISCUSSION

Gurd (loc. cit.) described his method as a diagnostic procedure for fat embolism. After filtration of the serum through a microfilter he found greater differences between serum and
filtrate in trauma cases and in patients with clinical signs of fat embolism. According to Gurd’s description it should be possible to stain the retained fat globules on the filter-paper. He described fat globules up to 40 microns in size.

Upon filtration of the serum and staining of the fat on the filter-paper we found an even distribution of positive and negative results in all three groups of patients. In no case did we observe fat droplets larger than 15 microns in diameter. Furthermore, we found marked variations in the size of fat globules when a positive test was repeated.

According to our experience the filtration technique is difficult to standardise. After repeated filtrations of the same sample we obtained differences in the triglyceride concentrations of the filtrate of up to 15 per cent.

Calculation of the differences in triglyceride concentrations between serum and filtrate in our three groups of patients revealed no statistically significant differences. The quantitative analysis of the triglyceride on the filter revealed rather low values which evidently leads to significant errors in the determination. This might also be the reason for the variations in the staining procedure. For the most part, the microscopic findings did not correspond to the serum-filtrate difference in triglyceride.

In clinical and experimental studies of fat embolism, Peltier (1954), Bryans and Eiseman (1955) and Bergentz (1961, 1968) observed a tendency for an aggregation of circulating fat and formation of larger fat droplets.

Our findings of a significant correlation between serum triglyceride concentration and the amount of triglyceride on the filter in fat embolism in patients could indicate that their serum contained triglycerides transported in globules of a size exceeding the filter pore size. However, it seems questionable whether these larger globules can be removed quantitatively in a standardised way by means of a simple mechanical filtration.
In conclusion, our results do not support the suggestion that Gurd's method is a reliable aid in the diagnosis of fat embolism. Moreover, in cases of clear-cut clinical fat embolism syndrome with corresponding necropsy findings, we found the test misleading.

SUMMARY

1. Blood from forty-one healthy volunteers, seventy-one patients with fractures but without symptoms of fat embolism and seven patients with clinical evidence of fat embolism was examined microscopically for fat droplets and chemically for triglycerides.
2. Fat droplets, after Millipore filtration of the blood, were seen evenly distributed in all three groups.
3. There was no significant difference in triglyceride concentration between serum and filtrate in the three groups.
4. The results do not support the thesis that the Gurd test is a reliable aid in the diagnosis of fat embolism.

The original results reported in this communication were supported in part by the U.S. Army through its European Research Office (Current Contract No. DAJA 37-72-C-0603) and by grants in aid from the Swedish Medical Research Council (B72-17X-536-08C, B73-40X-2042-07A, B73-40P-2485-06B). The generous assistance of AB Bayer Farma, Stockholm, Sweden, is gratefully acknowledged.

REFERENCES